CIVIL ENGINEERING

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ON THE HOME FRONT—TROOPS PROTECTING MISSOURI FARM LAND FROM RISING MISSISSIPPI FLOOD WATERS (SEE ARTICLE, PAGE 379)

Volume 14 — *Number 9*

SEPTEMBER 1944

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MALCOLM ELLIOTT has been 38 years with the Corps of Engineers, mostly on river and harbor and flood control projects, as a civilian employee until World War I, and since then as a commissioned officer. He worked on Panama Canal construction, the Ohio River slack-water navigation system, Muscle Shoals Dam, Mississippi River outlets to the Gulf, Alaska highways, and locks, dams, and flood control works on the Mississippi.

L. F. CHEN (Chiao-Tung U., Shanghai '23) in China was a power-plant engineer, superintendent of an electrical works, chief engineer of a power plant, and assistant general manager of an electrical manufacturing works. He is now a representative of the National Resources Commission of China in the U.S.A., and president, American Section, Chinese Institute of Engineers.

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WALTER GRIESBACH (Queen's U., Kingston, Ontario, C.E. '12) spent 6 years on harbor construction work with the Public Works of Canada. In 1918 he went with the Foundation Company as Office Engineer, and in 1928 was made Chief Engineer. In this capacity he has been engaged in engineering and construction work throughout Canada.

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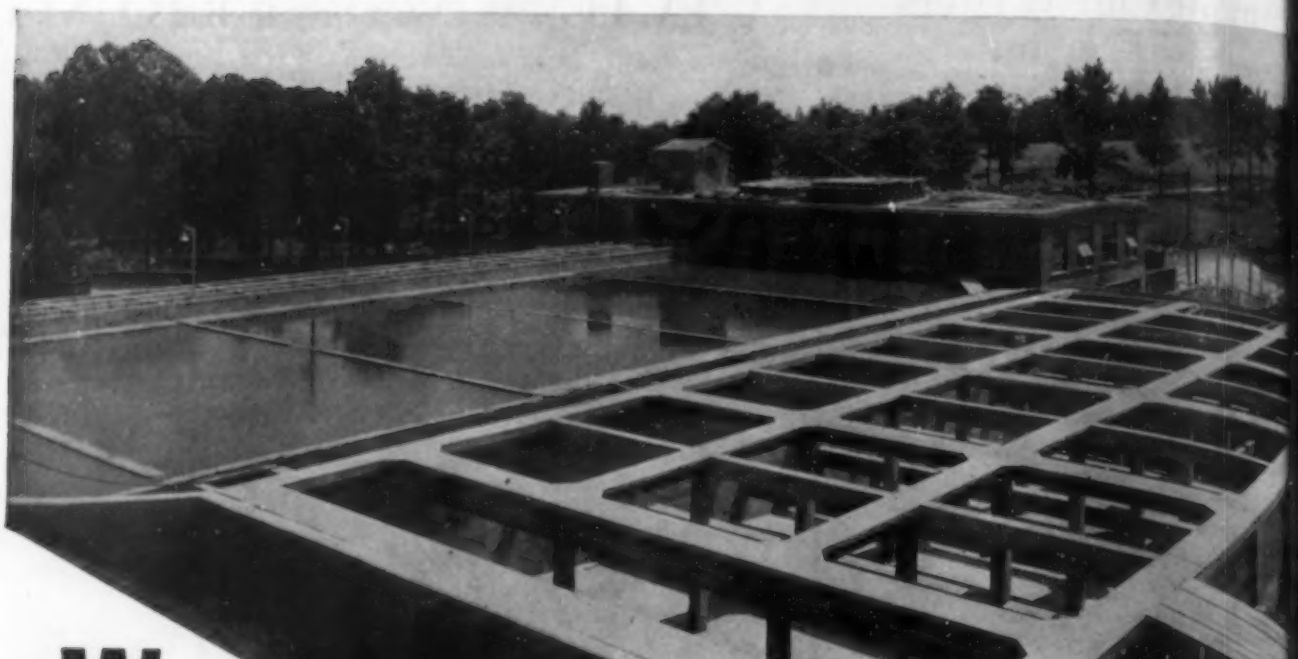

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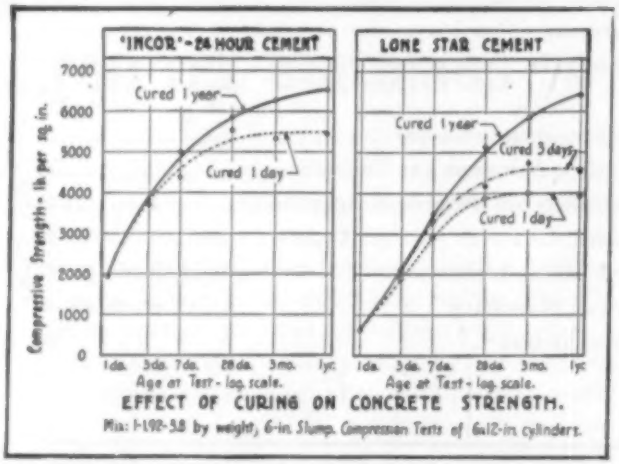

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Chart for the Future

President's Annual Address Projects Lessons from Past Experience and the Present Emergency

By MALCOLM PIRNIE, PRESIDENT, AM. SOC. C.E.
CONSULTING ENGINEER, NEW YORK, N.Y.

AS members of a learned profession, engineers have manifest duties now that the problems of peace are becoming more pressing. They must appreciate the great heritage of American representative government and they must build on the glorious past to ensure a commensurate future. Developing this thesis, President Pirnie points specifically to constitutional rights and their maintenance, to international cooperation for peace, and to national educational policies. As required by the Constitution, this address was prepared for the anticipated Society Convention in Cleveland. Since this had to be abandoned, immediate publication in "Civil Engineering" was arranged to give all members an opportunity to study these proposals.

PRESENT recording of the experiences of the past is the tried-and-proved method of making a chart upon which a successful voyage into the future may be plotted. Eternally colorful words of Patrick Henry forcefully express this fact:

"I have but one lamp by which my feet are guided, and that is the lamp of experience. I know no way of judging the future but by the past."

Liberty-loving peoples of the earth are now engaged in the greatest of recurrent revulsions against unbearable usurpation of the unalienable rights of all men by powerful human cliques. They were so engaged in Patrick Henry's day, when that New World crisis brought forth annunciation of a great principle, upon which this nation was founded.

OUR FOREFATHERS PLANNED FOR PEACE

The concordant discoveries of the world's most revered scholars and teachers were selected by Thomas Jefferson to guide him in his task of wording the Declaration of Independence. He said of his work, "I do not consider it as any part of my charge to invent new ideas altogether and to offer no sentiment which had ever been expressed before." Thus, resistance to invasion was cemented in the heat of battle just 168 years ago by defining the cause of the people clearly in a simple 112-word declaration of the unalienable rights of men and a recitation of the usurpation of many rights which had been suffered. The representatives of the first thirteen states pledged to each other their lives, fortunes, and sacred honor in signing the Declaration. Victory was finally won by men willing to endure great hardship for a common cause, so clearly defined in the light of their experience that they were willing to die to establish their declaration as the birthright of their descendants.

When every effort was being exerted to define the purpose of our Revolutionary War and to support the armed forces from pitifully limited resources, comparable labors were undertaken at the same time to define and implement the peace. A committee to devise a plan for a union of the States was appointed by the Continental Congress on the same day that the Committee was appointed to formulate a Declaration of Independence. The resulting Articles of Confederation were reported to Congress eight days after the first Independence Day.

Inevitably, the jealous retention by the States of the newly proclaimed rights of their citizens produced a national government with insufficient powers even to give its armed forces the support they so desperately needed. A decade of bitter internal and external experience ultimately resulted in Congress's calling the first Constitutional Convention. Presiding over the deliberations of that convention of distinguished men, representative of their respective States, was George Washington, engineer, military leader, and statesman. In 1791, when the first ten amendments were adopted after the last of the thirteen States ratified the Constitution, a sovereign people had instituted and endowed with just powers the Government of the United States of America to secure the rights of the people.

PROGRESS BASED ON THE CONSTITUTION OF THE UNITED STATES

The Constitution of the United States is figuratively a chart recording the depths, the shallows, and known currents of the age-old struggle for individual freedom among men. Ventures into the future have been plotted on this chart in vast numbers during the century and a half of its existence. They are the voyages of free enterprise into the future, with courses set from known positions on the chart. The promise of security thus made available was sufficient to justify the risk of life and property in the search for new products and services for

the use and convenience of man. The unleashed capacity of a people to make effective use of its rights raised living standards within this brief period of time to more than double those attained during all the preceding centuries.

A veritable avalanche of new conveniences and time-consuming pleasures aroused the desire to enjoy them. This multiplied incentive for constantly increasing production. In the scramble to produce and enjoy such mounting abundance, there was diminishing time given to thought of the source of such freedom and its protection. Developments in education lagged far behind the knowledge needed to convert the products of free enterprise into blessings of permanent benefit. So engrossed were the people in the problems of their separate fields of endeavor that the clouds of a powerful reactionary storm to usurp the unalienable rights of all men broke with inhuman force over a large part of the world before our nation began to awake to the imminence of its peril.

FRANTIC WAR EFFORTS

Not until England's Dunkirk did the flow of outmoded material and equipment start across the Atlantic in relatively insignificant aid of her heroic resistance. We took in exchange grants of sites for defensive bases and proceeded to construct such bases in feverish haste. In November 1940, our voters recorded their approval of the proposition that their Army and Navy would not be called upon to fight beyond our national boundaries. Then, thirteen months later, Japanese carrier-borne planes dove out of the clouds on a Sunday morning and destroyed the greater part of our Pacific Fleet snugly tied up in Pearl Harbor. This assault was patterned on maneuvers of the winning squadron in an earlier American fleet war game. A few hours later our air force was destroyed on the ground in the Phillipines. These tragedies had to happen before sound reasoning and common sense could replace comfortable wishful thinking and willingness to let the incompetent do what thinking was done.

There has followed in the succeeding two and a half years an astounding demonstration of the productive capacity of free enterprise energized by almost complete unity of purpose. There was planning and action which vastly accelerated development of transportation and communications, which provided the facilities required to create and implement huge armed forces and a Navy with auxiliary ships strong enough to carry the war to the enemy and to deliver needed supplies to our embattled Allies. These developments have conclusively demonstrated that the old world, with the natural barriers behind which some nations formerly were able to isolate themselves, no longer exists.

PROFITING FROM LESSONS OF EXPERIENCE

Now that communications can be instantaneous and commerce can span distances in hours instead of days or weeks, ventures into the future must be planned on this latest radical revision of the chart recording our experiences. The peoples of this new earth must learn to work harmoniously for the common good. Otherwise they will destroy potential progress and each other. The present speed with which implements of destruction are produced and applied over land, mountains, and oceans warns nations of the future horrible consequences of their failure to live in harmony with their neighbors. The United States of America and allied nations, whose citizens have experienced freedom to use many of their "unalienable" rights, are now well on the road to force unconditional surrender of the Axis powers, whose citizens gave all their rights to government in exchange for its vain promise to make them lords over a subservient world.

There is too little time left before Victory for our country to plan adequately to solve its internal problems of reconversion from a wartime to a peacetime basis. There is too little time left to plan with care our foreign relations. The most that can be done within the limited time available is to take the demonstrated truths from the chart of experience and express them so clearly that the vast majority of our people can understand the destination of what should be a proud venture into the future and will determine to set forth in that direction. Devious courses undoubtedly will be undertaken, but with the aid of instantaneous communications and interpretations by representatives of the people selected from those best qualified for their respective tasks, our nation can be kept advised of positions reached which are definitely off-course and of those most likely to reach our destination.

FREE ENTERPRISE IS ESSENTIAL

As great a need exists in our nation today as existed in the days of the Continental Congress for the inspired leadership, universal discussion, and prayerful thought which were devoted to the creation of our birthright. We must here and now resolve to give a substantial part of our time for considered thought to rebuild the protections of our rights, and reach beyond our borders to offer the aiding hand of true friendship to peoples less fortunate than our inheritance has made us. Of necessity, this must be a continuing process depending upon the development of the capacities of peoples to use effectively such rights as they may from time to time possess. Here in this nation we can neither stand still nor regress. We must progress to higher standards of lifetime service to justify to our people our rich inheritance and to other peoples of the earth their sufferance of our existence.

During the past decade, many small units of free enterprise have been forced out of existence or to seek protection in affiliation with large units. New obstructions on the chart of recorded experience have appeared to cause this trend. A threat resulting in such demonstrated discouragement of ventures into the future of a formerly greater number of small units of free enterprise also presents dangerous hazards to be navigated by the surviving larger units. The most important immediate assignment for the best qualified among our leaders is to remove these obstructions as fast as possible, to reestablish incentive for the development of free enterprise.

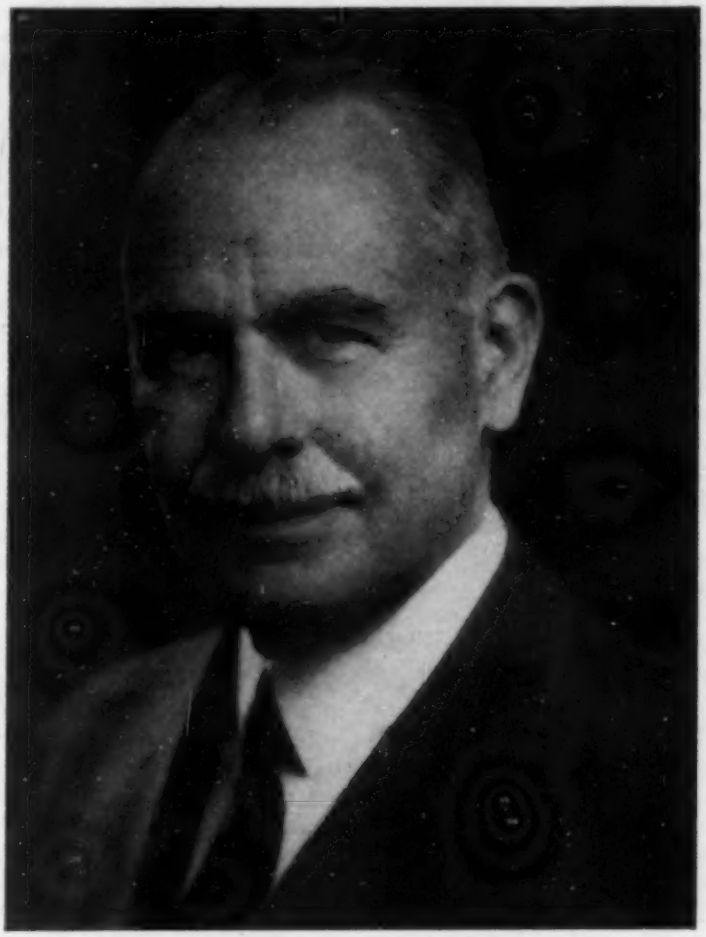
THE ENGINEER IS INARTICULATE

Where does the engineer stand in the present call for best qualified leaders to interpret the chart of experience to define the destination of ventures into the future so clearly that the vast majority of his fellow citizens will plot their courses in that direction, and to offer suggestions as to courses which he believes may be most likely

prove successful? The engineer must admit that he is largely responsible for planning the phenomenal advances made in harnessing power to aid men in the development of mass production, in the acceleration of transportation, and in the accomplishment of instantaneous communications. To accomplish so much in so short a time, he has concentrated his effort almost to the extent of his full capacity for thought within his chosen limited field of applied science.

Taught to plan his creations with due regard to their usefulness related to their costs, he has made more and more material things available to his fellow men in exchange for less and less effort required of them. The engineer has also aided in the development of entertainments to absorb the increasing free time of the people. Recreation time, formerly available for physical exercise, study, thought, and discussion is competed for by absorbing programs broadcast into every home and by tempting amusements that can be reached by a drive in the family car.

The engineer has given too little thought to the social effects of the results of his enterprise. The engineering profession is inarticulate because it is separated into a number of limited specialties. Within each special field, engineers discuss their problems in language which is foreign even to many engineers in other fields and totally uncomprehendable by the general public. On the chart of experience the present position of the engineering profession is a galaxy of isolated spots, only a few of which are on the proper course to a desirable future destination.



MALCOLM PIRNIE, PRESIDENT OF THE SOCIETY

IS THE SOCIETY CONVENTION NOT ESSENTIAL?

If concrete proof of this conclusion were needed, it was received during the writing of this address in a communication from J. Monroe Johnson, Member of the American Society of Civil Engineers, and a devoted public official as Director of the Office of Defense Transportation. He requested that the Summer Convention of the Society at Cleveland be canceled on the grounds that it offers nothing in the immediate effort of winning the War commensurate with the transportation facilities it would use. He, of course, is in possession of facts as to the immediate War need for the transportation facilities we are asked to relinquish, and it is his duty to balance those needs against available facilities.

Many engineers are traveling all over the world on priorities equal to those of military personnel in order to make their specific services available where and when they are required. It is regrettable that an immediate convention of representatives of the engineering profession is not considered of sufficient importance to be recognized as a paramount contribution in the war effort and an indispensable guide to the preservation of the institutions for which our armed forces are fighting and dying.

PRESENT CHART FOR IMMEDIATE USE

Today, standing on the threshold of the greatest opportunity for service that the world has yet offered them, engineers have a grave responsibility in the development of a sound national and international program. To begin this assignment, engineers must join hands across the boundaries of their specialties and work together to remove unnecessary obstructions to future ventures of free enterprise and to chart a safe course toward lasting peace with organized justice in a free world. They must be adequately represented in the departments of government, on committees of business men advisory to government, and among the delegates who will negotiate a lasting peace.

To be entrusted with such responsibilities of representation of their fellow citizens, a majority of these must first approve the principles and propositions for applying them offered by the engineers. It will not suffice to know an engineer designed the best airplane engine or a bridge to span a great river. The people will always take such qualifications for granted but will need assurance that the engineer understands many of the present problems confronting the nation as a whole, which are in fact engineering or closely related problems. Concrete evidence that engineers, representative of the entire profession, recognize the grave responsibilities of their greatest opportunity for service in world development toward lasting peace, must be formulated now and submitted in comprehendable form for criticism, revision, and majority approval by their fellow citizens.

To this end, let us consider the following four propositions. It is necessary that each should receive considered

thought and criticism provocative of clearer expression of principle. The development of other propositions equally important is omitted here in the desire to focus initial attention on an obviously important few.

PROPOSITION 1—HUMAN RIGHTS

The Declaration of Independence states in part:

"We hold these truths to be self-evident
"That all men are created equal;
"That they are endowed by their Creator with certain unalienable rights;
"That among these are life, liberty, and the pursuit of happiness:
"That, to secure these rights, Governments are instituted among men, deriving their just powers from the consent of the governed;
"That, whenever any form of Government becomes destructive of these ends, it is the right of the people to alter or to abolish it, and to institute a new Government, laying its foundation on such principles, and organizing its powers in such form, as to them shall seem most likely to effect their safety and happiness."

With the authors of the Declaration of Independence we recognize that the statement quoted above is restricted to rights and does not imply present equality in capacity and will of individuals to use such rights effectively and for the common good. Rights are equal and unalienable at birth. For the use made of such rights the individual is accountable to his Creator and to his fellow men only to the extent that their rights are transgressed.

PROPOSITION 2—CONSERVATION OF RIGHTS

The "American way of life" can be continued and improved in spite of an increasing complexity of activities and new developments. This is possible only if a substantial majority of the people believes and will aggressively assert the principle simply phrased by Walter Lippmann:

"In a free society the State does not administer the affairs of men. It administers justice among men who conduct their own affairs."

Constitutional checks upon the natural human tendency to exercise power beyond the boundaries of authority granted by the people must be made equally mandatory upon all agencies established by Congress to direct details of administration of the collective needs of free enterprise within well-defined boundaries of the delegated authorizations.

PROPOSITION 3—PERMANENT PEACE

Leaders of opinion at the recent so-called Mackinac Conference subscribed to the following statement, which is stated by Sumner Welles to be unexceptionable and in accordance with the spirit and the letter of the President's announced plan. "We favor responsible participation by the United States in postwar cooperative organization among sovereign nations to prevent military aggression and to attain permanent peace with organized justice in a free world."

To start implementing these principles, an international congress representative of the Allied Nations should be inaugurated at the earliest possible date.

The Allied Congress should be directed:

1. To make a declaration of principle.
2. To prepare articles of joint responsibility in undertakings to prevent military aggression.
3. To draft a charter or constitution under which representatives of free peoples can organize justice and support its development to gain majority approval and respect to the end that permanent peace may ultimately be attained.

PROPOSITION 4—EDUCATION FOR CITIZENSHIP

A people endowed with reverence for good should be urged to adopt universal education to develop capacity to produce good works.

Facilities for education designed to increase incentive to develop good citizenship and acquire knowledge should be perfected in competitive balance with the productions of the people's enterprise. Incentive to expand production will increase in proportion to unalienable rights entrusted to the people.

In the United States, incentive to acquire good citizenship and knowledge is insufficient to compete with the development of time and labor-saving conveniences and time-consuming diversions. Education designed for the tempo of average capacity is productive of lazy mental and disruptive social habits for half of the pupils endowed with greater-than-average capacity to develop qualities of good citizenship and to acquire knowledge.

AN IDEAL WORTH FIGHTING FOR

Free debate upon these four propositions will clarify their wording to convey meanings acceptable to a substantial majority of free citizens. The principles involved are fundamental and must be understood as the foundations upon which millions of special fields for free enterprise developments can be established. Government pronouncements through agencies of new rules that transgress justice, which has earned majority respect and support of a people through past ages, are productive of uncertainty to the point of chaos in the administration of justice.

Never before in history has so dependable a chart been created as that recording the scant two centuries of experience of our nation. It must be a bright lamp by which our feet are guided if we are to form sound judgment in directing our future course. Engineers must join in charting a course secured by references to those established landmarks which have assisted in guiding our nation to its present greatness. We must never depart from the course so clearly set forth in the most inspired of all state documents, the Constitution of the United States.

All citizens entrusted with public office and accepted into the armed forces have sworn to support and defend the Constitution. We are united with our Allies to defeat the demonstrated end-product of National Socialism. On the home front we must voluntarily swear to understand, defend, and perpetuate the national institutions responsible for the American way of life to the end that the sacrifices we are demanding of our armed forces shall not be in vain.

Lessons in Flood Control

Need for a Coordinated Program Makes Flood Control a National Enterprise

By MALCOLM ELLIOTT, M. AM. SOC. C.E.

COLONEL, CORPS OF ENGINEERS, U.S. ARMY; DIVISION ENGINEER, UPPER MISSISSIPPI VALLEY DIVISION, ST. LOUIS, MO.

"THE levee's gone out!" Indescribable is the terror this cry brings to thousands of Americans living in the flatlands of the Mississippi River system. Nearly every year millions of dollars worth of crops, buildings, roads, and even top soil are washed away in another disastrous flood. As Colonel Elliott points out, effective flood control, despite its costs, can easily be justified if the sum total of damages is considered. Clear skies and low water do not mean that "It ain't goin' to rain no more." This plea for a coordinated control program was one of the papers presented at the St. Louis regional meeting. Others are in prospect for publication in later issues.

THERE was a time when flood control was considered a local matter for solution by the eas affected, with little if any re- urse to federal aid. But, in keep- g with the progressive broadening the scope of federally financed blic works, flood control has now en declared a national enterprise. e Act of June 22, 1936 (Public o. 738, 74th Congress) provides at the federal government should prove or participate in the im- rovements of navigable waters or eir tributaries, including their atersheds, for flood-control pur- ses if the benefits, to whomsoever ey may accrue, are in excess of the timated costs, and if the lives and cial security of people are otherwise adversely affected. Congress has also specified that in administering this olicy investigations and improvements of rivers and her waterways for flood control and allied purposes hall be prosecuted under the direction of the Secretary War and the supervision of the Chief of Engineers. has also specified that investigations of watersheds and easures for the retardation of runoff and water flow and r the prevention of soil erosion shall be prosecuted by e Department of Agriculture under the direction of the ecretary of Agriculture.

Within the framework of these established policies, lans for essential flood control projects have been and e being set up by the appropriate agencies. Congress, r specific authorizations in the uture, may determine in what rder and at what rate the arious watersheds are to be ven protection.

The occurrence of damaging oods in two successive years the midsection of the Mis- ssippi River system has em- hasized the need for flood con- ol there. In 1943 an April ood that did great damage in e upper reaches of the Mis- uri River was followed by ex- ssive rainfall in a belt extend- g from Indiana across Illinois nd most of Missouri, produc- g a truly enormous flood in ay and June. We cannot be o sure of past records, but urely few people now living re- all any higher water than was en in 1943 on the Illinois, iddle Mississippi, and lower eaches of the Missouri River.

The waters remained over ood stage in these areas until nearly the end of May, which of course is well into the best planting season. As if this were not enough, along came another flood early in June which kept the lands under water until the first of July—too late for extensive 1943 planting. Some of the same area was again flooded in 1944. Thus the St. Louis gage, twice in eleven months, registered greater heights than had previously been experienced since 1844.

A STANDING PROBLEM

The first lesson we should learn from experiences such as these is that floods are a perpetual peril, and something ought to be done to prevent or mitigate them. Whatever may be the sum total of the damages, I am convinced that it is more than enough to justify a reasonable flood prevention program. Let us enumerate some of the damages:

1. Flooding of farm lands—the rich bottoms adjoining our main streams and tributaries.
2. The wasted labor of cultivating and seeding ground and the despair of the farmers whose livelihoods depend on these crops as the waters rise and quench the life from their sprouting plants.
3. The deposition of gravel and sand on top of fertile loam soil.
4. The ruin, or damaging, of farm buildings.
5. The frantic efforts to get back on the land after the first flood in the hope of getting some kind of a crop before

DEVASTATION FOLLOWED THIS BREAK IN A MISSISSIPPI RIVER LEVEE AT CLARYVILLE, MO., IN MAY 1943

RELENTLESS WAR AGAINST THE RISING WATERS BEING WAGED BY TROOPS

winter, only to see all the work wasted by a second, larger flood.

6. Flooding of communities and entire disruption of every normal activity—the expenses of moving out and moving back and cleaning up when they get back.

7. Cessation of industry and resulting unemployment.

8. Destruction of highway and railroad bridges and road beds and immobilization of traffic, which is essential always in daily living but doubly essential in time of war.

9. The vast expenditure of resources and efforts to prevent or mitigate flood damage and relieve suffering.

10. Finally, but by no means of least importance, the loss of lives.

All of these losses and more were inflicted on the Illinois, Mississippi, and Missouri valleys during the floods of 1943 and repeated to some extent in 1944. Soil conservation, reservoirs, and levees do not grow by magic. They are the product of months and years of designing and construction. Admittedly a nation-wide system of flood control will consume years of time and billions of dollars. We should not, while the streams are behaving, forget that the time will surely come when they will go on the rampage. So I think the first and most obvious lesson from these floods is the necessity, in the interest of national welfare, of preventing such disasters in future or at least of mitigating their effects.

A GENERAL PROBLEM

The next lesson, which has been demonstrated by recent experience, is that flood control is not a local problem. Many of the flood control measures heretofore adopted and put into effect, especially levees, have failed to afford relief because they were planned and built in relation to local flood problems and not in the light of the general flood problem.

Reservoir systems should be coordinated with levee systems, and the overall flood-control development of one basin should be coordinated with that of other basins which combine with it to form larger basins. Thus the flood control works on the Missouri, the upper Mississippi, the Illinois, the Ohio, the Arkansas, and other rivers must form part of the flood control system of the entire Mississippi River Valley. Since the water of all these tributaries eventually unites in the main stream, no one of them can be regulated without regard to the effect on the others.

A GROWING PROBLEM

The third lesson to be learned is that floods must be held in greater respect than in the past. We must not be fooled by a succession of dry years into believing that we can take liberties with the flood plains. We have laws that restrict and govern encroachment on waterways to the detriment of navigation but there are no general statutes that prevent the building of all sorts of obstructions in flood channels. The effect of these obstructions is of course to raise flood heights so as to damage not only the offending structures but many innocent ones as well.

There have been enthusiastic advocates of various specific methods of flood control to the exclusion of others. But in my opinion there is no one cure-all. Different methods fit different situations, and in large flood control systems all accepted methods may have their place within the general framework.

RESERVOIRS ALONE NO CURE

Let us consider first reservoirs, and inquire whether they alone can furnish complete protection against floods. To avoid flooding of valuable lands, reservoirs should generally be located at upstream points either on the main stream or on its tributaries, where waste or unproductive lands predominate. This means that regardless of the capacity of the reservoirs, rains falling downstream from their outlets are left uncontrolled, and unfortunately these areas may dump into the stream enough water to produce enormous floods. This is what happened when Omaha was attacked by flood in April 1943. Fort Peck, 1,200 miles upstream, collected only a part of the flood waters, leaving all the drainage below, including the Yellowstone, Cheyenne, and James rivers uncontrolled. Although Fort Peck reduced the flood at Omaha about $2^1/_2$ ft, the damage was still very great.

Systems of reservoirs have been proposed and adopted for several of our great valleys, and when built will control very substantial proportions of the various watersheds. However, such systems will leave without reservoir control the rainfall on many thousands of square miles where storms can concentrate and produce sizable floods. The floods from these waters can usually be taken care of only by levees or other local works. Reservoirs alone will not cure floods.

On the other hand, levees alone usually will not provide a safe and practicable system of flood control. They protect land from overflow but their confining effect

tends to raise flood heights, thus creating a sort of vicious circle. Furthermore, levees are nearly always critical structures. Intensive maintenance and emergency protection are generally needed when the water is high. Despite these troublesome characteristics, levees afford one of the surest and most direct methods of securing local control of moderate floods. The flood elevations to be protected against are reasonably well known; the levees necessary to provide the needed protection can be designed and their cost estimated with reasonable accuracy; and the remedy is applied where the trouble occurs. Levees are useful for local flood control but will not solve the overall problem.

A FLEET OF AMPHIBIOUS JEEPS USED TO BATTLE FLOODS

Other single remedies are often proposed—with more or less enthusiasm—as the sure and exclusive remedy for floods. For example, we occasionally see published statements that floods can be entirely prevented by soil conservation, terracing, and contour plowing.

CONTRIBUTING CONTROLS

I emphatically do not wish to oppose the conservation of soils and other natural resources. These enterprises in their own right are entitled to hearty support. The protection of forests and soils is as worthy as any other public work that we can envision which will retain for posterity the abundant gifts bequeathed to us in trust. But at the same time we should not spread the fallacious doctrine that forestation, erosion prevention, contour plowing, and so forth will of themselves eliminate the flood menace in our immense alluvial valleys. We can do no worse service to soil conservation and retardation of runoff than to claim extravagant benefits which they cannot reasonably be expected to give. Soil conservation in all its aspects will retard runoff and lessen the silting of channels and reservoirs, but it will not prevent dangerous floods.

There is an old adage that "You can't eat your cake and have it too." This applies to flood control reservoirs. They cannot receive flood waters if their capacity has been used for some other purpose.

The idea that reservoir systems can be used for conflicting purposes by seasonal variations of storage is beguiling, but successful operation in the best interest of all purposes would involve an ability to predict future weather conditions which I fear we do not possess. For example, in combining flood control and power in one system, it might be thought that the reservoirs, after being held at a low level for flood control during the late winter and early spring months, could safely be filled, say early in May, so that ample water and head will be available for power during the summer and fall months. It is true that in some years the maximum dual use of the reservoirs could thus be obtained. But suppose a storm with 10 to 15 in. of rainfall occurs in May or June just after the reservoirs have been filled—where is the storage for flood control? It can't happen? It did happen in the Osage Valley in 1943, when a flood poured down on a full reservoir which could not to any significant extent reduce the peak discharge. Disastrous consequences were averted by only a narrow margin.

SANDBAGS ADD A FEW MORE FEET TO THE HEIGHT OF A LEVEE, AS THE RIVER THREATENS TO OVERTOP IT

To hold reservoir usage strictly to the purposes for which they are designed may require courage and the ability to withstand intense pressure, especially when the damages and distress accompanying the last big flood have faded in

RESCUES ARE COMMONPLACE AS COUNTLESS HOMES ARE FLOODED

our memories. The necessity of evacuating a flood control reservoir as soon after it is filled with flood waters as can be done with due regard for the safety of the lands downstream from the reservoir is obvious. If this is not done a second flood may come along, and conditions could then be worse than if no reservoir had ever been built. If we are depending on reservoir storage to take the peaks off of high floods and the storage capacity has been used for storing water for irrigation, power, or any other purpose, the reservoirs will not accomplish the purpose for which our hopes, our money, and our labor have been expended.

FLOOD CONTROL AND STORAGE

Fortunately, it is possible in many instances to provide reservoirs that will allocate a definite number of acre-feet of capacity for each of the purposes. Irrigation, power, and flood-control storage requirements can be determined and provided. But after this has been done and the plan of operation has been determined accordingly, we should not allow ourselves to be persuaded—however plausible may be the arguments—that we can still have flood control if we use the storage space for irrigation, power, wild life, or other purposes.

We have lately heard proposals that privately owned hydroelectric power plants be operated in the interest of flood control. I doubt if any policy to attain this objective can be set up for all power projects without greatly depreciating them as sources of power. Power uses stored water. Flood control uses storage space. The two cannot exist at the same time at the same place unless the reservoir has capacity for both. Perhaps the most that can be required in the public interest with respect to reservoirs built primarily for power is that sufficient governmental supervision be imposed to prevent power reservoirs from causing or aggravating floods.

Flood control is, of course, a vital problem in most of the basins of the United States, and each basin has its own particular problem and its own most desirable method of treatment. Yet no river basin that is tributary to another can be treated altogether as a separate entity. Reservoirs in the Allegheny, Monongahela, Muskingum, and Tennessee valleys, besides affecting their own valleys, are a part of the comprehensive system affecting the Ohio River to which they are tributaries. Similarly and on a larger scale, this Ohio River system, together with possible similar systems in the Missouri, Arkansas, and other basins, must be considered a part of a comprehensive Mississippi basin system in which the interests of over thirty states are involved.

In my opinion, a comprehensive system demands comprehensive design and layout and unified management. Otherwise, I see no escape from unfortunate reservoir operations which, though possibly beneficial to certain small watersheds, might produce disastrous combinations of flood discharges on the main stem. Direction of the location, design, construction, and operation of flood-control projects should, subject to such limitations as Congress sees fit to impose, be unified from the point where a stream enters the sea to the uppermost flood control reservoirs on the principal tributaries.

In conclusion, I will summarize a few of the fundamentals of flood control that recent floods seem to have exemplified:

1. The ultimate necessity for reasonable and economically feasible projects for the control of floods in our fertile and productive valleys.
2. The need for considering flood control projects not only in respect to the localities immediately affected but also in respect to other localities in the same river system.
3. The need for sufficient control of agricultural and industrial development to avoid indiscriminate and wasteful building of improvements in flood-menaced localities.
4. The useful employment of all feasible measures for flood control, including prevention of soil erosion, retardation of water flow, and building of storage reservoirs, channel improvements, and levees.
5. Sufficient supervisory control of hydroelectric power reservoirs to make sure that their operations do not cause or aggravate floods.
6. Avoidance of the fallacy that flood control storage can be used or encroached on for other purposes and still fulfill its primary purpose of flood control.
7. The organization of unified flood control management so that an entire valley from the coast to the uppermost flood control reservoir can be operated consistently and for general benefit—particularly to avoid operation of tributary basins to the detriment of flood control below where the tributaries enter the main stream.

In one respect floods are like wars. We are prone to assume that we can't have another one. It takes a war to prove the need for national defense; it takes a flood to prove the need for flood control. During the past two years we have had proof of this fact. Now we have an adopted national policy, and the technical and administrative skills for carrying out the policy. We have the resources for the orderly prosecution of meritorious public works. All we need is the determination—and I think we have it—to retain flood control as a national objective and furnish the means for accomplishing it in a consistent and orderly fashion.

Engineers Will Build the China of Tomorrow

A Plan for the Development of a Self-Sufficient Nation

By L. F. CHEN

PRESIDENT, AMERICAN SECTION, CHINESE INSTITUTE OF ENGINEERS

EVEN while their nation is engaged in a very real struggle for survival, the Chinese are formulating a 20-year plan of economic development. The program includes extensive transportation facilities, power plants, and industries of all sorts. Indicative of the scope of the plan is the housing goal of 50 million new homes. In this paper, which was presented before a meeting of the Metropolitan Section of the Society, Mr. Chen stresses the need for foreign capital and equipment in carrying out the program.

CHINA is a very old country; its culture can be traced back in an unbroken line to the Stone Age. Chinese history goes back to before 2000 B.C. For about forty centuries, China lived almost entirely within herself, not having much to do with the outside world. The social system in ancient China was organized mainly on the basis of four classes of people. Named in their order of importance, they were the scholars, the farmers, the craftsmen, and the merchants. Thus the Chinese valued their scholars and farmers much more highly than they did their industrial workers and merchants. This is one reason why China has lagged behind in industrial development.

It was not until the fifteenth or sixteenth century that China began to engage in trade with foreign countries. Toward the middle of the last century, China started to feel the increasing pressure from the sea, which resulted in her first war with the British in 1839, when the Chinese government tried in vain to stop the opium traffic on the coast. The resulting Treaty of Nanking was the first of China's unequal treaties. Treaty ports were opened, extraterritorial rights were established, and special tariff rates were granted to foreign imports. Since then, foreign goods have been dumped in China and foreign factories opened; these enjoyed special privileges and were not under the jurisdiction of Chinese laws. The local Chinese industries which were still in their infancy could hardly compete with the foreign ones and therefore their growth was greatly impeded. This is another reason why China's industries have not developed as they should.

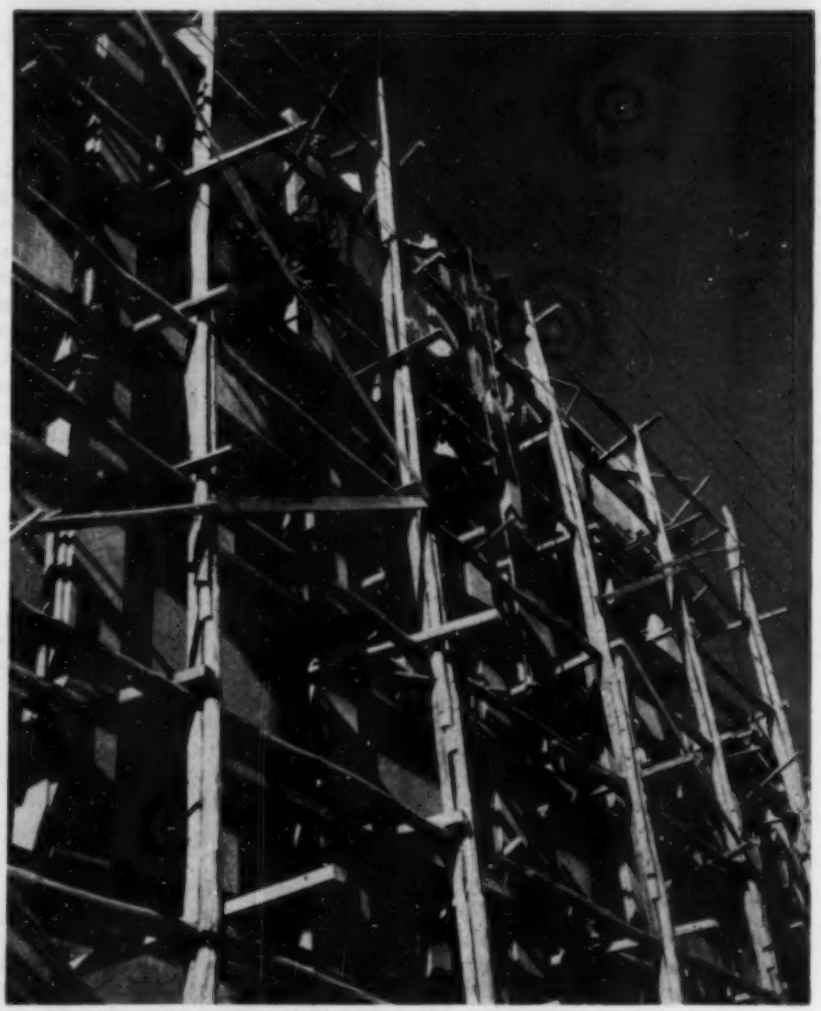
EFFECT OF WAR ON INDUSTRY

Early in the present century, the Chinese revolution broke out, led by Dr. Sun Yat-sen, and in 1911 the Manchu Dynasty was overthrown and the monarchy changed to a republic. Political upheavals and civil wars followed the revolution, and Chinese industries again suffered.

Then came the Japanese invasion of Manchuria in 1931, and China's war with Japan in 1937. At that time, most of the industries were located in big cities along the coast. The Chinese government moved more than six hundred industrial plants to safety in the interior. Many other plants were either destroyed by war or seized by the Japanese. Thus China's new industrial development was seriously affected.

Conditions in China have changed greatly during recent years. First of all, many farmers have gone to work in factories, to drive trucks, or to run machines. Many others who used to wear long Chinese gowns have changed over to shorter coats or put on overalls so that they could work better with their hands. Twelve years ago, there were three times as many college students majoring in literature, law, commerce, and education as were majoring in science, engineering, medicine, and agriculture. But now, the number of the latter far exceeds that of the former.

Unequal treaties in China have recently been abolished and extraterritorial rights relinquished. About a year ago, China concluded new treaties with the United



SCAFFOLDING FOR A FIVE-STORY STRUCTURE IN KUNMING
For Housing and Business Uses Extensive Building Is Planned

REPLACEMENT OF PRIMITIVE TRANSPORTATION METHODS IS URGENTLY NEEDED
Supplies at Chungking Being Moved by Hand

States and Great Britain on the basis of equality and reciprocity. This marks the beginning of equal privileges and opportunities for all peoples doing business in China, a condition which will undoubtedly bring about a much closer cooperation between Chinese and foreign industries and will help greatly to quicken the process of industrialization in China. When the war is over and peace finally won, China will definitely be on the way to nation-wide industrialization.

THREE-YEAR PLAN

Under the necessities of war, the Chinese government, like the governments of most of the other countries in the war, has played an important part in the development of basic and heavy industries. When the Japanese attacked China in 1937, the National Resources Commission of the Chinese Government was engaged in creating an industrial area, under a three-year plan, in the central provinces of Hupeh, Hunan, and Kiangsi. When the fighting area shifted from the coast further toward the interior, these government-operated industries—half finished or barely started—had to be moved to southern and western districts and built all over again.

In order to answer the urgent needs of war, new plants have been set up in the interior. The Chinese Government was confronted with insurmountable difficulties in the removal of these plants to the interior and in the construction of new ones. The situation was afterward aggravated by the Japanese blockade of the coast. All imported machinery and materials had to come, first, through French Indo-China, later through Burma, and now only by air transport from India to Kunming. In spite of all these handicaps, the Chinese Government has attained substantial success in its pro gram. The progress made in creati new heavy industries may be seen fro the fact that the number of industri plants has increased six times in the la seven years, while total production ha increased more than ten times.

PRESENT DEVELOPMENT

At present, the National Resourc Commission has under its control 105 i dustrial units engaged in manufacturin mining, and the production of powe There are 9 iron or steel plants; an electr chemical plant; a copper refinery; 6 ma chine works, of which one specializes i prime movers and machine tools; 5 plant producing electrical equipment; 8 alcoho distilleries; 2 synthetic oil plants; 5 alka and fertilizer plants; 4 agencies for ex porting such minerals as tin, tungste and antimony; many mines, including 3 coal mines; an oil administration; an ex ploration office for oil and natural gas and 22 electric power plants. With a few exceptions, all the electric power plant in the interior of China are operated b the Commission. The Commission now has a technical staff of 12,000 and em ploys 170,000 workers in the different en terprises.

Of course, all that China has accom plished industrially during the last seven years of war with Japan would seem a trifle as compared with what has been done in the United States since Pearl Harbor. But, considering the extreme difficulties under which we have had to work, we have really done the very best with what we have.

China's industries of tomorrow must be built to serve two distinct purposes. During this war, China has suffered so much from the lack of munitions and mecha nized weapons. For the last seven years, people in China have been fighting virtually with human flesh and blood. The odds have been all against them. Through all the ordeals of these seven long years the Chinese have certainly learned one lesson and have made up their minds that such unequal combat shall never occur again. Of course, China is a peace-loving country and all Chinese are peace-loving people. But in order to protect their national integrity and maintain their very existence they know that it is necessary to build up a strong industrialized China so that blood-thirsty aggressors cannot again perpetrate such crimes. So from the standpoint of national defense, China must catch up in her industrialization as quickly as possible.

STANDARD OF LIVING MUST BE RAISED

Then there is the great problem of poverty. More than 80% of the people of China live on farms. Because of the lack of modern equipment to increase farm production and the lack of transportation facilities to distribute farm products, China as a whole is not self-sufficient in food, or in other necessities of daily living. Under the stress of war, economic conditions in China have become worse. It is only by building up various industries that the population can be saved from starvation and poverty and the standard of living raised. Therefore from the standpoint of national economy also, China must be industrialized as quickly as possible.

On the basis of these two fundamental requirements—national defense and national economy—Dr. Sun Yat-sen, founder of the Chinese Republic, laid down twenty years ago the basic principles and overall plans for the industrial development of China. Since then, work has been carried on to coordinate and to perfect such plans.

BASIC INDUSTRIES WILL COME FIRST

When building a new house, the owner always wants to make it as spacious and comfortable as possible. There are always a lot of nice things that he would like to have in his house and some other things that his wife feels she cannot afford to miss. Since it is impossible to have them all, they must be satisfied with what they can get within their means. Similarly, in building up a country like China, it would be desirable to develop many different kinds of industries, as large as possible and as quickly as possible. Since China's ability to do so is very limited, especially at the beginning of reconstruction, it is necessary to start in with those industries that are most basic, most urgent, and most useful. If the Chinese cannot have both farm tractors and pleasure cars, then they will choose the tractors first. If there is not enough steel to make both ball bearings and cigarette lighters, then the steel must go to ball bearings. Therefore, in planning for postwar industries in China, it is not a question of what is wanted, but of what can be had, how much, and how soon.

Among the industries to be started immediately after the war, the basic and heavy industries are the most important. Among these are the mining of coal, iron, and other essential minerals; the steel industry; chemical industries; oil wells and refineries; and factories to make trucks, tractors, farm equipment, machine tools, electrical apparatus, and other necessary products. Steam and hydroelectric power plants are needed to supply power and lighting to industrial districts, to cities and towns. Another thing of equal importance is the development of transportation facilities and communication systems. Railways and motor roads must be built all over the country, and at the same time ships and improved waterways are needed to transport raw materials and industrial products and to effect better distribution of farm produce and commercial goods.

To give a rough idea of the size of the job planned, the following figures are quoted from the recently published book, by Generalissimo Chiang Kai-shek, called *China's Destiny*. As a goal for postwar industrialization, it is planned to build 100,000 miles of railroads, 1,000,000 miles of motor roads, 24,000 locomotives, 300,000 railway cars, 7,000,000 automobiles and trucks, 120,000 airplanes, 14,000,000 tons of ships, 4,000,000 machine tools, and power plants with a total generating capacity of 20,000,000 kw. It is also planned to produce in every year 150,000,000 tons of coal, 5,000,000 tons of iron and steel, 1,700,000 tons of petroleum and oil, 30,000 tons of tin, 25,000 tons of copper, 25,000 tons of tungsten, and 20,000 tons of antimony. For clothing, it is planned to add 10,000,000 spindles to the textile mills. Construction of 50,000,000 new homes is also planned. At first view, all these figures may seem fantastic. But considering that China has a population three times that of the United States, and an area of $1\frac{1}{2}$ times, it will still be far behind the United States even if this goal is reached. It will take China at least twenty years to realize this plan.

END OF A RAILROAD LINE IN SOUTH CHINA
Construction Was Halted by Japanese Invasion

RUBBLE NEAR CHANGTEH'S EAST GATE IS TYPICAL OF THE BOMBED CITIES OF CHINA

CAPITAL AND EQUIPMENT NEEDED

To carry out such a plan, at least four things are necessary—capital, equipment, raw materials, and manpower. In the matter of capital for its industries, China's own financial ability will be rather limited, especially at the beginning. It will not be sufficient for rapid growth and large-scale expansion of industry immediately after the war. It will therefore be necessary to look to foreign countries, especially the United States, for financial cooperation and assistance. This aid might be in the form of loans, bonds, long-term credits, or straight

TRAFFIC PASSING OVER A NEW BRIDGE WHICH REPLACED AN OLD ONE "SOMEWHERE IN CHINA"

financial participation in Chinese industries by foreign private interests. The Chinese government has recently adopted a policy that encourages foreign investment.

As regards supplies of equipment and machinery, it will again be necessary to depend mostly on imports from foreign countries to start China's postwar industries. It will be quite a long time before enough equipment and machinery can be made in China to supply its industrial needs.

As for raw materials, China has many natural resources but the trouble is that they are mostly still underground. It will be necessary to spend a great deal of time and effort to make these resources available. So there again the importation of industrial raw materials will be essential to meet immediate requirements after the war.

Last but not least is the problem of manpower. Of this there is no apparent shortage. Yes, there are plenty of manual laborers, but there are far too few skilled workers. An acute shortage of trained personnel has been experienced during the war. It is estimated that at least $2^1/_2$ millions of technicians and trained workers will be required in Chinese industry in the first ten years after the war.

VAST NUMBERS OF ENGINEERS NEEDED

Now, with all these facts in mind, what are engineers going to do to help build the China of tomorrow? One thing I can say for sure, engineers are going to play the most important part in the postwar reconstruction of China. It is difficult to imagine how many civil engineers will be needed in China to build 100,000 miles of railroads and 1,000,000 miles of motor roads; how many mechanical engineers to manufacture all the locomotives, cars, planes, ships and machinery; how many electrical engineers to install and run all the power plants; how many chemical, metallurgical, mining, and other kinds of engineers to develop all the different industries. There are at present only a handful of such engineers in China. Certainly vast numbers of different kinds of engineers will be required to do such work as soon as postwar industrialization is started. We engineers in China have an enormous job on hand. It will take the best of our ability and utmost of our effort to do it well.

China's engineers have not had to start industries from scratch. Many years have been spent in developing industries in America and elsewhere and there absolutely is no reason why the Chinese should have to repeat all the experimentation and research already done. The greatest benefits will be secured through readjustment and readaptation of established principles and methods to suit local conditions and requirements in China. The Chinese are therefore looking to American engineers and American industries for technical assistance in doing a better, quicker and more efficient job.

There is absolutely no doubt that China will be industrialized as soon as the war is over. To what extent this will be done and how fast will depend in large measure on the general situation in China after the war. But at least this can be taken for granted—that there will be unlimited opportunity for both Chinese and foreign engineers who are willing to take an active part in the building of China's industries of tomorrow.

KUNMING BANK, ONE OF CHINA'S NEWEST AND TALLEST BUILDINGS

Reed-Backed Fences for Channel Protection

By J. A. Bradley, Assoc. M. Am. Soc. C.E.
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Most natural and artificial storm-water channels in Orange County, California, require some form of protection if their banks and levees are to be safeguarded from scour and washouts during times of heavy storm runoff. Where this trouble occurs, either the material composing the waterways is of a light sandy nature or the grades are steep enough to induce eroding velocities.

Since the great flood of March 1938, the Orange County Flood Control District has constructed several miles of channel protection works of different classes. One of the most successful and economical types consists of wire-mesh fencing supported on rail or pipe piles cabled together and backed up with reeds tied in bundles and securely attached by means of wire ties. The practice in the smaller channels has been to use pipe piles as supports for single-line fences of wire mesh and reeds. The piles are driven at angles to suit the bank material retained and still give a fairly efficient hydraulic shape to the channel section for its designed capacity. In the larger channels, where greater quantities of water and higher velocities are found, it is necessary to support single-line fences on rail piles driven vertically (Fig. 1).

The accompanying photographs of protection work along Trabuco Creek show a portion of a completed fence of the heavier rail-pile type located on the outside of a rather sharp bend in the channel. Former erosion in this bend of the stream has now been arrested and several acres of good citrus land protected. This work was done during the spring of 1942 by the Flood Control District, using force account methods. Subsequently, on January 23, 1943, the fence was subjected to, and successfully passed, a peak flow of 2,850 cu ft per sec. The amount of this peak was determined in a straight section of the channel at a point downstream and had the following dimensions: width, 90 ft; maximum depth, 4.5 ft; and mean velocity, 11.5 ft per sec. Undoubtedly the effect of turbulence along the curved portion of the fence was considerable. Several smaller peak flows have occurred since without having any pernicious effect on the structure.

The photographs, taken in June of 1943, show no apparent damage to the fence. There were no holes in the backing after the flood as is sometimes the case with fences filled or backed with ordinary brush. In observing flow along these fences it appears that water is unable to get a sufficient hold on the bundled reeds to loosen them. If such fences are properly constructed, water filtering through the reeds to the bank side no longer has an eroding velocity.

Economies were effected by obtaining used material for parts of the work. Ninety-pound used rails 30 ft in length were driven vertically on 12-ft centers with their tops at grade at 7.5 ft above the channel bed. It was necessary that these rails be straight but they were not "re-laying" material; a "re-rolling" grade was found to be satisfactory. The driving was accomplished with a drop-hammer weighing 2,600 lb, which worked in hanging leads suspended from a 50-ft dragline boom. Before driving, a trench deep enough to give a 2-ft bury to the wire mesh and reed bundles was excavated using a $1^1/_4$-cu yd bucket on the dragline.

Three lines of used $^5/_8$-in. steel wire rope were stretched taut, wrapped, and securely clamped as shown in Fig. 1. To these cables and piles, two widths of new 58-in. type "I" galvanized wire mesh were firmly wired at about 1-ft intervals with double wrappings of No. 9 gage galvanized wire. A horizontal lap of 8 in. was allowed between the two widths of wire mesh. No vertical joints in the wire mesh were permitted between piles.

Reeds 12 to 14 ft in length for the backing material were cut from dense growths along river levees, where they are grown especially for bank protection. They were placed approximately 10 to the bundle and tied tightly once around the middle and at each end. The bundles were hauled by truck a distance of 24 miles for this particular job, laid in horizontal rows beginning with the bottom of the fence, and tied at intervals with No. 12 gage galvanized wire. Gravel-wash material from the channel bed of the stream was then placed behind the finished fence by means of the dragline.

Costs for a total of 2,676 lin ft of completed work at this location were as follows:

Labor	$4,381.32
Material	4,112.55
Equipment charges	3,398.07
Engineering and overhead	900.06
Total	$12,792.00

A typical levee protection fence using pipe piles driven on a slope is illustrated in the photograph showing the Fullerton Relief Channel. A $^3/_8$-cu yd dragline with a 30-ft boom was used to excavate for the fence trench. The bucket was then replaced with a set of hanging leads and the pipe driven with a 1,200-lb drop-hammer. Lengths of used pipe $2^7/_8$-in. in outside diameter, 14 ft in length, and weighing 5.79 lb per ft, were driven on

Two Views of Reed-Backed Rail-Pile Protective Fence Along Trabuco Creek, in Southwest Orange County, California

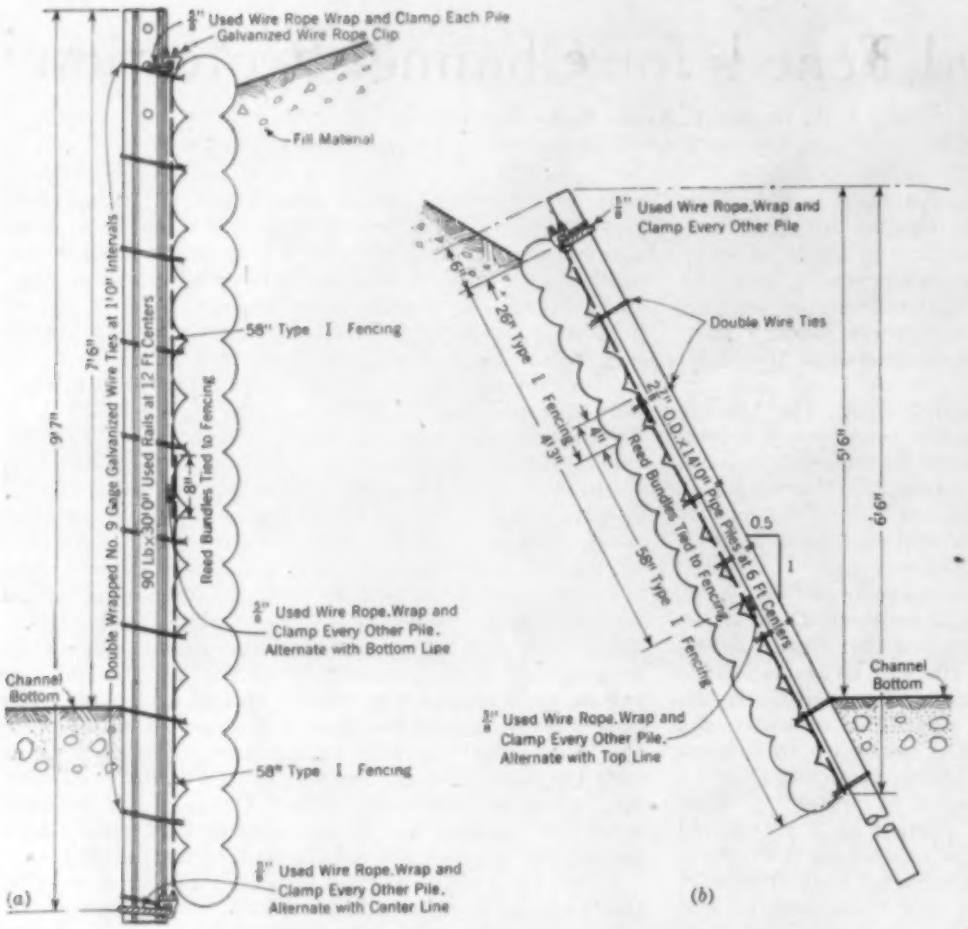

FIG. 1. TYPICAL DESIGNS OF CHANNEL PROTECTION FENCES

6-ft centers at the grade and slope shown in Fig. 1 (*b*). Two lines of used ⅜-in. wire rope were stretched, wrapped, and clamped to the piles. One 58-in. and one 26-in. width of wire mesh were fastened on as before described and the bundled reeds placed behind them. Reed-placing operations were followed closely by backfilling, the level of the fill being maintained only slightly below the top of the bundles.

COSTS OF CHANNEL PROTECTION WORK

The District, using its own forces, completed 680 lin ft of this type of construction at two locations on this channel during the fall of 1942. Costs were as follows:

Labor	$452.48
Material	500.75
Equipment charges	205.42
Engineering and overhead	60.55
Total	$1,219.20

The Indians found many uses for the reeds that grow in many of our Southwestern States. They used them for lattices in the construction of adobe huts, for carrying nets, as shafts for arrows—in fact, wherever a tough, flexible, and durable material was needed. Makers of musical instruments, after proper curing of the plant, use certain parts for the reeds of clarinets and organ pipes. The reeds grow well in the climate of Southern California, especially al streams and in areas of sa soil with high ground-wat The accompanying photogra of a levee along the lower San Ana River shows the densen and height of the growt Reeds often reach a height 20 ft in from two to three yea after the rhizomes are set o and require no cultivation other care. The reed grow along these levees serves a tw fold purpose—it protects th sand levees from scour b streamflow and wind, and furnishes material for backi fences like those that ha been described.

However, during the d season the fire hazard is se ous and it is necessary to ke roadways cleared on top of th levees so that fire-fightin equipment can reach the sce quickly. It is also necessar to maintain frequent patrols t watch for fires and to eje trespassers. There seems to b a temptation for unauthoriz persons to try to obtain thes reeds for their own use in mak ing ornamental fences, ho houses, and even bean pole

It is evident that the co of growing reeds for flo protection uses alone woul be excessive. To keep the costs of cultivation at a mini mum, the District entered into a mutual agreement wit a corporation specializing in the manufacture of ree for musical instruments.

This contract requires the corporation, at its ow expense, to make all patrols and additional planting requested by the District, and in return the District permits the corporation to cut and harvest selected stalks Since the growth is quite rapid, even when the olde stalks are cut out, and the corporation's requirements are low, the Flood Control District already has a potentia supply of material for protection-fence backing which is sufficient to last for many years.

(LEFT) REEDS GROWING ALONG THE SANTA ANA RIVER, READY FOR HARVESTING; (RIGHT) A PIPE-PILE FENCE ALONG THE FULLERTON RELIEF CHANNEL

The Shipshaw Hydroelectric Project, Canada

III. Construction Methods

By WALTER GRIESBACH

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"SPECTACULAR" is perhaps the best one-word description of the construction of Shipshaw No. 2, a 1,200,000-hp development. To climax the exploit, an 82,000-lb dynamite shot removed the rock plug separating the tailrace from the river. An unusually rapid construction schedule was adhered to despite wartime difficulties in obtaining equipment. This article by Mr. Griesbach completes a series on the Shipshaw project which began in the July issue. The series has been published through the cooperation of "The Engineering Journal" of the Engineering Institute of Canada.

ONE of Canada's major contributions to the war effort has been made by the Aluminum Company of Canada, Ltd., in the completion of the Shipshaw power development. The site is on the Saguenay River, a few miles upstream from the Aluminum Company's main plant at Arvida, Que. Authority to proceed with the construction of the No. 2 development was granted to the general contractor on May 15, 1941. The first power was delivered from the project on November 24, 1942, about eighteen months later. In this time 4,200,000 cu yd of earth was excavated, 2,560,000 cu yd of rock moved, and 697,000 cu yd of concrete placed.

All branches of the preliminary work—including clearing of the site and building of roads and railroads, a town site, service buildings, and machine shops, compressor house and air lines, pump house and water lines, heating plant and steam lines, transformer installations and electric power lines, and rock-crushing and concrete-mixing plants—were carried out simultaneously in order to expedite actual construction operations.

Altogether 430 acres of the site were cleared, and a total of 16 miles of roads and 17 miles of standard-gage railroad were built to provide highway and rail connections and ready access to all parts of the work. The town site was centrally located on the north bank of the Saguenay River, and included administration buildings and housing and feeding accommodations on an upper level, and service buildings and yards on a lower level along the river bank.

The work of the mechanical department was a most important factor in making it possible to meet the construction schedule. The problem of keeping all the plant and equipment in operating condition was a big one on account of the scarcity of plant and the speed of operations required. The machine shop was provided with 28 pieces of modern equipment including lathes, presses, drills, welding outfits, grinders, a planer, a shaper, a milling machine, a shearing machine, a power hacksaw, a bolt-threading machine, and a 600-lb steam hammer. To effect economy in the use of tires, two vulcanizing machines were installed in the tire repair shop, one to handle the ordinary run of automobile and truck tires, the other exclusively to repair the 12 by 24-in. and 14 by 24-in. tires for the larger trucks.

Over two-thirds of the volume of concrete to be poured was concentrated in the area at the east end of the head channel (Fig. 1), and No. 1 plant was located in this vicinity. With the exception of the primary crushers, the rock-crushing and concrete-mixing plant was all outside the flooded area. The primary crushers were located at the end of a heavy rock cut in the head channel to facilitate the supply of crusher feed from the rock excavation. No. 2 plant, equipped to provide about one-third of the total volume of concrete, was at the west end of the head channel.

After the completion of the Chute à Caron extension, the concrete mixing plant was moved over to Shipshaw and set up as No. 3 plant at a convenient point to receive aggregates from No. 1 plant. It was used during the peak period to supplement the main plant in supplying special mixes for certain parts of the work.

To assure a daily average of about 2,500 cu yd from the No. 1 plant, it was decided to use four 2-cu yd mixers to provide ample capacity to take care of unforeseen delays, and to meet peak demands. The section from the primary crushers, through to and including the classifying bins, was duplicated to allow for repairs and screen replacements, and to give sufficient capacity to maintain an ample supply of aggregates in the stock piles. Each half was designed to produce about two-thirds of the mixer requirements. Four sizes of coarse aggregate were needed—$^1/_4$ to $^3/_4$ in., $^3/_4$ to $1^1/_2$ in., $1^1/_2$ to 3 in., and 3 to 6 in. The percentages of each size were 20, 14, 18, and 22, respectively. Then 26% of sand completed the average mix. The crushers were set below grade so that there would be a minimum of demo-

EXCAVATION OF POWER-HOUSE SITE AND TAILRACE—TRESTLE CARRIES CONSTRUCTION ROADWAY

FIG. 1. GENERAL LAYOUT OF SHIPSHAW PROJECT

lition work required after their removal, and prior to the flooding of the head channel.

EARTH EXCAVATION

In the head channel a large earth cut amounting to 700,000 cu yd extended from the control works downstream for a distance of 2,600 ft. The soil being of a sandy nature and ideal for scraper work, this section was sublet to a road contracting firm. Scrapers and tractors with bulldozers were used on this work. Other earth excavation in the vicinity of the head channel totaled about 1,000,000 cu yd. The excavation included stripping of overburden in the head channel and at dam sites as well as the digging of several drainage ditches. Over areas where rock was used for crusher feed, the rock surface was cleaned by hand. The different kinds of soil encountered included sand, humus, blue-clay, sand and gravel, and gravel and boulders.

Unwatering of the foundations was not a major problem, but considerable pumping was required in addition to the digging of several drainage ditches.

The excavation was done with $1^1/_2$ to $2^1/_2$-cu yd draglines or shovels, and disposal was by trucks or tractor-tread wagons to low areas adjacent to the head channel. At Dam No. 5, a 4-cu yd dragline loading into 20-cu yd, standard-gage, side-dump cars was used. All side slopes in the head channel were riprapped with 3 to 6-in. crushed rock, or the run of the primary crusher, spread to an average thickness of 9 in. by means of bulldozers and also by hand.

In the power-house and tailrace area, the greater part of the earth excavation, amounting to over 1,200,000 cu yd, consisted of sand and gravel. Two draglines, one with a 100-ft boom and 4-cu yd bucket, and one with a 138-ft boom and 6-cu yd bucket, were used to remove the overburden to a depth of about 50 ft. The material was loaded into 20-cu yd, standard-gage, side-dump cars, and hauled to disposal areas adjacent to the tailrace by 40-ton steam locomotives. Working two 10-hour shifts, these two machines averaged 6,000 cu yd per day.

Before power could be delivered on the scheduled date of November 20, 1942, it was necessary to remove sufficient of the earth-fill dam at the control works to provide for the flow through the head channel. This work was done with the larger of the draglines just mentioned. The first cut was made in the dry, on the downstream slope, before erection of the gates in the control works was completed. When all six gates were finished, about the end of August 1942, water was pumped from the forebay into the area between the earth dam and the control works to equalize the head on the dam, and the final cut to grade was started. The material was disposed of in the flooded area below the control works clear of the head channel, in 20-cu yd, standard-gage railway side-dump cars carried on a timber trestle.

ROCK EXCAVATION

The rock is an anorthosite, a coarse-grained igneous formation composed essentially of plagioclase feldspar. On account of the typical jointing, joints parallel to three or more intersecting planes, it had a tendency to break in large angular blocks when blasted. Because of its crystalline structure, it had a slight tendency to break in long pieces in the primary crusher, but made good concrete aggregate. It is slightly softer than granite but considerably harder than limestone. There were 2,486,000 cu yd of rock excavation in all the open-cut work. In the head-channel, power-house, and tailrace areas, where the maximum depth of rock to be removed was as much as 105 ft, two or more cuts were made. Under the control works, dams and wing walls, where there was only a minor amount of loose and weathered rock, a cut of from 2 to 5 ft was sufficient to reach a satisfactory foundation. At one point in the north wing wall, it was necessary to excavate to a depth of 32 ft on account of a fault which cuts across the foundation.

The drilling equipment consisted of various makes of well drills, wagon drills, sinkers, various makes of lighter jackhammers, and diamond drills, which were used on special work in the tailrace only. The spacing of well-drill holes varied from 8 to 10 ft, and of jackhammer and wagon-drill holes from 3 to 5 ft, depending upon the depth of the face. In general, well-drill holes were used where the face was 18 ft or over, wagon drills and sinkers for cuts from 8 to 18 ft, and jackhammers for the shallower cuts and secondary drilling. Wagon drills were also used for drilling horizontal lifter holes at the bottom of deep cuts.

Exclusive of the tailrace plug, an average of one pound of dynamite was consumed per cubic yard of rock excavated. In well-drill holes, 75% dynamite was used, in other blast holes 60%. Except in shallow cuts and trenches, rock excavation was done with $1^1/_2$ to $2^1/_2$-cu yd shovels loading into 2 to 4-cu yd standard dump trucks, 10-cu yd trucks, and 10 and 13-cu yd tractor-tread wagons. Most of the rock from the control works, dams, wing walls, and the trench adjacent to the tailrace plug was loaded by hand into skips which were handled by crawler cranes. All general excavation, with the exception of that from the head channel, which was required for crusher feed, was wasted in disposal areas adjacent to the head channel and tailrace.

To facilitate operations in the power-house area and particularly in the tunnel work, a 35-ft roadway was excavated down to tunnel grade at the rear of the power house, with a ramp leading to the upper levels at each end. At the portals, the rock was cut back from the roadway to provide at least 30 ft of vertical face over the tunnels, and sufficient width to accommodate the steel wyes and penstocks. The tunnels were driven by the full-face method, with the exception of 3 to 6 ft of invert left in place to provide a temporary level roadway. The drilling was done wet, from a drill carriage or jumbo with a battery of 24 power-feed drifters mounted on the front end. Each machine was mounted on a swing dump on a universal column arm. Three working platforms provided ready access to the face and sides of the tunnel and served as storage areas for both sharpened and dull drill steels. Cantilevered extensions were provided at each side, which could be removed when moving the jumbo in or out of the tunnel. The complete carriage was mounted on caterpillars. The total weight, including 50 sets of drill steel, but exclusive of the weight of caterpillars, was 23 tons. The jumbo was also used as a platform for scaling the surface of the tunnel.

ROCK PLUG PERMITTED EXCAVATION OF TAILRACE IN THE DRY

REMOVAL OF TAILRACE PLUG

After making careful studies of various ways of taking care of the final break-through from the tailrace to the river, it was decided to leave in place a natural rock barrier or plug, as it is commonly called, and blast it instantaneously after all work was completed in the east half of the tailrace.

The rock in the whole tailrace area was first leveled off to El. +50, and then taken out to grade, working from the power house towards the mouth of the tailrace. On account of the seamy nature of the rock, it was decided to excavate to grade +5 to within 130 ft of the downstream face of the plug, and to provide a secondary plug as a safety measure against leakage by excavating a trench down to grade immediately upstream of the final plug. It was also decided to excavate a sump below the tailrace floor on the upstream side of the plug for the purpose of retaining as much as possible of the final shot below tailrace grade. Advantage was taken of the existing low water in the river to reduce the final volumes by excavating the area over the main plug and trench down to El. +40. A concrete retaining wall with crest at El. +45 was then built along the center of the plug to take care of the fall floods. After a trench 16 ft wide was excavated down to El. −10, with very little trouble from leakage, the secondary plug was removed, and the sump was excavated down to El. −10 for a distance of 40 ft back from the plug, and then carried up on a 20% slope to meet the tailrace floor. This sump provided storage space having a volume of about 13,000 cu yd.

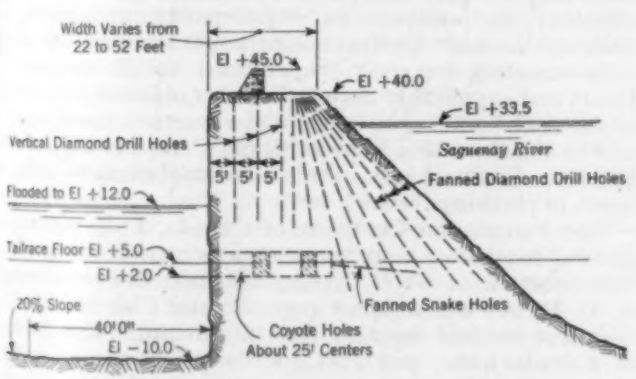

FIG. 2. SECTION SHOWING METHOD USED TO DISPOSE OF ROCK PLUG AT TAILRACE

The plug contained about 18,000 cu yd. It was 310 ft long, with the east end about 75 ft south of a line normal to the tailrace wall at the west end. It was 35 ft high, and the top width varied from 22 to 52 ft. The downstream face sloped at an angle of about 45 deg. A careful survey was made of this face to serve as a guide in drilling the plug. (See Fig. 2.)

Most of the drilling was done with diamond drills, using bits $1^7/_8$ in. in diameter. Vertical holes were drilled on 5-ft centers, and up to 8 diagonal holes were drilled from each setup at 5-ft intervals along the downstream edge. The ends of the plug were close drilled with vertical and fanned holes. Well drills were used in the wider section at the west end. Twelve coyote holes 3 ft wide by 4 ft 6 in. deep were tunneled into the plug at about 25-ft centers, with bottoms at El. +2. The holes varied in length from 15 to 40 ft, and contained up to three sets of loading pockets on each side. Additional drill holes, extending out to near the sloping face of the rock, were fanned out from the ends of the coyotes.

Loading of the holes was started November 17, a day before the completion of the drilling, and was completed on November 19, 1942. An average crew of 80 men placed a total of 81,750 lb of dynamite, which consisted of 5,000 lb of 75% polar forcite in a portion of the well-drill holes, and 76,750 lb of 80% giant gelatin in all other blast holes and coyotes. An average of 4.5 lb of dynamite was used per cu yd of rock, and 26,800 lin ft of

DAM 3-B CONCRETED IN VERTICAL LIFTS AND ALTERNATE BLOCKS

primacord detonating fuse was used in connecting up the complete charge.

Prior to the blast, the tailrace was flooded to El. +12 only, or to about 5 ft 6 in. above the top of the coyote holes. While it was desired to have some cushioning effect against flying rock from the coyotes, the water on the other side of the plug was down to El. 33.5, and it was believed that the greater the difference in head, the greater would be the volume of blasted rock which would be carried into the sump. The shot was fired at 11.07 a.m. on November 21, 1942, and although there was some slight damage done to both temporary and permanent work at the east end of the power house, it was considered a very successful shot, as subsequent soundings indicated less than 500 cu yd of blasted rock to be removed. This material has since been taken out by a 2-cu yd scraper. Altogether about 600,000 lb of drill steel and 3,360,000 lb of dynamite were used in removing 2,630,000 cu yd of rock.

CONCRETING DAMS AND WING WALLS

On account of the nature of the topography, most of the concrete was transferred from the mixing plants to its destination by trucks. Two types of buckets were used for carrying the concrete, 2-cu yd controllable bottom-dump buckets, and standard 2-cu yd bottom-dump buckets. To hold the buckets in place, 4 by 6-in. timbers were bolted to the truck bodies. For dumping directly into hoppers, where the concrete was conveyed to its place in the forms by elephant trunks or buggies, the concrete was carried in 2 by 2 by 8-ft steel boxes mounted on steel-body trucks. These boxes were provided with a top-hinged door on the rear end for discharging the concrete from the raised body. Some of the concrete was delivered on flat cars carrying two 4-cu yd buckets to Dam No. 5, where a convenient track had previously been laid at the time the crushers were installed in the head channel.

The buckets were handled from trucks or cars by crawler cranes or derricks. From 4 to 6 trucks were required per handling unit, and up to 400 cu yd of concrete per unit was placed in one 10-hour shift.

In the dams and wing walls, a total of 467,000 cu yd of concrete was handled directly into place in buckets by derricks and crawler cranes. Concrete was poured in 5-ft vertical lifts in alternate blocks 38 and 40 ft long, with a five-day interval between pours. The 5-ft lifts were poured by building up layers the full length of a section to the full height, working away from the upstream face, as the joints are on a 5% grade sloping up from this face.

Within a few hours after completion of a pour, the top surface was cleaned off with an air-water jet, and was kept wet for a period of five days. Prior to the next pour, the surface was sandblasted, where required, to prepare a satisfactory bonding surface. A $^1/_2$-in. layer of grout was applied to the surface in advance of the concrete.

Panel forms to suit the 5-ft lifts, with form clamps and mild-steel tie rods $^5/_8$ in. in diameter, were used throughout. Except in the top section with vertical sides, where horizontal ties were used, the tops of panels were held in place by form clamps and rods set on 4-ft centers and sloped at 45 deg. The tie rods were attached by sleeve nuts to crimped anchor rods set 24 in. into the previous pour. The bottoms were held by clamps attached to the tie rods left in place in the previous pour. On the vertical face, it was found necessary to support the bottoms of the panels by horizontal anchors set near the top of the previous pour to overcome a bulging tendency caused by dumping the 2-cu yd buckets close to the forms. On the sloping side, the ties at the top of the panel were nearly normal to the face, and no trouble was experienced in using these for anchoring the bottoms of the panels in the succeeding pour. To support the top of the panels, 2-in. pipe braces sloped at 45 deg adjacent to the tie rods, were used. The upper end was separated from the face of the form by a wood block, which was removed when the concrete reached a sufficient height. A horizontal paneling effect was provided on the upstream face by means of a V-strip attached to the top of the panel forms. The forms were removed within three to five days after the concrete was poured. The concrete included in dams, shafts, tunnels, and power house totaled 874,000 cu yd.

An average of 3,960 men were employed per day in two 10-hour shifts. The daily peak was reached in June 1942, when 9,863 employees were included on the payrolls of the general contractor and subcontractors. The total number of employees hired—47,747—indicates one of the labor difficulties which had to be contended with.

At the beginning, the work carried an A1A priority, which was a very high one, but unsatisfactory on account of the great number of jobs holding the same rating. Later, when AA ratings were created, the job was given an AA1 standing on materials for the work, but any work for the armed forces got the preference on equipment.

Acknowledgment is gratefully made to the organization of the Aluminum Company of Canada, Ltd., for their considerate cooperation throughout the course of the work; to Aluminum Laboratories Ltd., and their consulting engineer H. G. Acres, M. Am. Soc. C.E., responsible for the design and engineering, for their efficiency and cooperation in preparing and issuing drawings to meet the fast construction schedule; to all subcontractors for their cooperation; to all manufacturers and suppliers of materials and equipment for their expeditious handling of orders under wartime conditions; and to the Canadian Ingersoll Rand Company Ltd., and the Canadian Industries Ltd., for their valuable assistance in planning the rock work.

The Foundation Company of Canada, Ltd., was the general contractor, and the work was carried out under the direction of V. G. Younghusband, vice-president. A. O. Hawes was resident engineer, and Charles Miller, assistant resident engineer, for the Aluminum Company of Canada Ltd.; and P. C. Kirkpatrick was resident engineer for H. G. Acres, consulting engineer to the Aluminum Laboratories Ltd.

Should There Be an Engineer in the President's Cabinet?

By H. L. Fruend, M. Am. Soc. C.E.

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ARE engineers inferior as administrators? In at least one branch of their broad field of endeavor, it is apparent that they are considered to be distinctly so. This is in the rapidly expanding field of public administration. It has long been realized that expenditures of millions of public dollars—affecting the lives of all citizens—must be administered by professionally minded people. And yet an impression is being spread that one group of professionals in particular—engineers—do not make good public administrators.

It is claimed that engineers lack vision, that they do not have the necessary faculty, as one authority on public administration writes, "of taking an occasional excursion into the realm of Utopia." The alleged mistakes of one prominent engineer in public administration are pointed to as a horrible example. Yet little is made of the fact that a big factor in the depression was financial wizardry coupled with legal and political connivance. However, no fault is found with professionals having legal and political backgrounds.

ENGINEERS IN INDUSTRY

Every large industry in this country has an engineering department. Engineers sit on the board of directors of practically all the large industrial corporations. Engineers are the trouble shooters of industry. Their achievements command the respect and confidence of the working force as well as of management. Industry accords engineering a voice in administration.

This has not been true for very many years. Our marvelous industrial growth has practically all occurred within the past fifty years. Most of the marvels of modern technology have been developed within the lifetime of living men. A chief engineer of one of the largest hydraulic machinery firms in this country, who was my classmate in college, was the first technical engineering graduate hired by his company, which profited by the knowledge of engineers as much as by any other factor.

Engineers have made their way in industry. And yet the largest industry in this country, with about 135 million stockholders, whose revenue absorbs a major share of private industry's earnings, accords engineering no voice in administration. For example, in the present Cabinet (as of August 1)—10 departments having 18 secretaries and under secretaries—there are by occupation ten lawyers, three bankers, two industrialists, one farmer, one labor leader, and one sociologist—no one with any engineering experience or training.

A nation that is two hundred and fifty billion dollars or more in the red is going to have to continue at hard work indefinitely. Hit-or-miss expenditures can no longer be afforded. Postwar plans are still in the semantic stage. The concrete thing so far is that somehow we are going to have to keep fifty-odd million or more able workers continuously and gainfully employed. Who is to do that? Management, engineers, and research men. And who is trying to tell them how to do it? Economists, statisticians, financiers, educators, personnel men, labor leaders, and public administrators. Then, too, there is to be a vast reservoir of public works to be kept on tap to take up the slack in industrial employment. Engineers are to design the works, politicians are to locate them, professional administrators to run them, and labor leaders to fix terms of employment. Everything is to be greatly systematized and standardized.

The plan offered here is relatively simple. It calls for no great change in established governmental procedures. It recognizes the functions of existing agencies and bureaus. It seeks no definite control of anything. Its services are strictly advisory. It will encounter much opposition from powerful groups having their own schemes. But if adopted it eventually will punch the bottom out of the pork barrel.

This suggested plan is to enlarge the President's Cabinet to include a consulting engineer, whose position would be similar to that of the Attorney General and whose title would be Engineer-Consultant. The powers of the Engineer-Consultant would be solely those of technical adviser to the President. No federal agencies, bureaus, or services would be assigned to his office or administered under his direction.

The Engineer-Consultant would, however, have the power at any time to investigate the activities of any agency conducting or supervising engineering operations for the Federal Government and to submit a confidential report of his findings and recommendations to the President, but he would be under no obligation to do so except on presidential request.

DUTIES, TERM OF OFFICE, STAFF

His regular duties would in no way interfere with his work as a consultant, and his primary duty would be to advise the President on the feasibility, need, and economy of all legislation and executive orders making provision for engineering services or involving the installation, operation, or administration of public works, or for conducting other engineering activities. In such capacity, his services as a consultant would be made available to congressional committees, federal bureaus, and other national agencies when and if requested. As an official member of the Cabinet, the Engineer-Consultant would be appointed by the President and would hold office only at his will and discretion.

To a large extent the staff would consist of recognized specialists in technical lines, whom the Engineer-Consultant might appoint either temporarily or permanently, and who would not be subject to Civil Service regulations. He would open such regional offices, either permanent or temporary, as might be required to conduct readily the duties of his office, and he would have the power to employ competent private engineering firms or professional engineers to conduct special studies or make a report.

The Engineer-Consultant would maintain a register of all professional engineering firms and technical engineering experts qualified to practice before his office and registered in the state wherein the work is to be done, or the engineering operations carried on.

To the maximum extent practicable, the consultant would select from this register an engineering firm or pro-

fessional engineer of recognized ability and standing to conduct specific investigations or studies—one who, in general, would be cognizant of local needs and requirements. The compensation for this consultation would be in accordance with such uniform schedules of fees or per diem rates for engineering services as might be adopted by the so-called national Founder Societies for the private practice of engineering.

Unless otherwise required by law or executive order, the Engineer-Consultant would assign any authorized project involving the design, construction, operation, or maintenance of public works, or the rendering of regular and continuous engineering service, to the proper federal engineering bureau or agency established for carrying on such work or related effort. The Engineer-Consultant would not carry on or supervise directly either the construction or the operation of any public project.

The Engineer-Consultant would keep the President advised upon the proper coordination of all federal engineering services to the extent of avoiding duplication and inefficiency, and he would have the power to effect the temporary transfer of engineering specialists and their staffs from one federal agency to another in order to conduct related engineering operations of the government more efficiently.

However, he would have no power to direct or to interfere with the work of any federal agency to the extent of impeding its regular operations or lowering its efficiency.

COOPERATION BETWEEN FEDERAL AND LOCAL AUTHORITIES

The Engineer-Consultant would endeavor to maintain the highest degree of efficiency in all federal engineering services and to cooperate with state and local authorities having a direct interest in any project. To this extent, his preliminary engineering studies and investigations would not be limited by claims of exclusive jurisdiction or regional control which might be held by any other department or body.

Features of this plan have been discussed at times with various officials and members of the Society. The principal objections raised were "Fine if it can be done, but they will never do it," and "Who would ever want to run it?" The time is ripe for engineers to add to their planning something for their own profession, to take a united stand on professional rights. If all engineering societies and all engineers could get together on this objective, they would have the power to attain it. The public accredits engineers with the two outstanding achievements of this war—mass production and conversion—and now it turns to them for help in reconversion.

From time to time similar proposals have been advanced to correct this evident defect. A brief examination of several such proposals follows.

1. A Federal Department of Public Works. Engineering operations of the government have become so vast and varied that centralization into one large bureau would become too complicated and unresponsive to the will of the people—in other words too bureaucratic. The need is for more democracy and less autocracy, for the so-called grass-roots approach. Such a department would need an office building larger than the Pentagon.

2. Technocracy. Back in the days of the depression, technocracy had quite a flare. The big lesson of this war is that some things just have to be done regardless of the degree of efficiency and the cost involved. This maxim in time of crisis is going to be carried over into postwar economy. Technocracy and totalitarianism tend to follow parallel paths.

3. Chief of Engineers of the U.S. Army. A movement is under way to expand this office to include direction of all federal works. The essentials of military training demand strict obedience to any order issued from above. Such training centralizes responsibility and will further socialize engineering. Real engineering service must have due regard for the initiative of the individual and accord some degree of independent judgment all down the line. Moreover, the Army has an essential military service to perform for which it should hold itself aloof from civil life. Originally all engineering was military. In this sense, Scheme 3 would be a backward instead of a forward step.

4. A Director of Engineering. He would have powers similar to those of the Director of the Budget and the Comptroller General. Activities would probably be circumscribed to a review of what has already been done or to authorizations to proceed under approved plans. It would be a restrictive rather than a constructive measure. A greater opportunity for initiative and direction in the initial stages of a project is needed.

5. An Engineering Commission. This would be similar to the Federal Power Commission or the Interstate Commerce Commission. Here again the tendency is to exercise a judicial rather than an administrative function so as to make all operations conform to a fixed set of rules. Enterprise would be smothered under a mass of red tape and petty detail. Like No. 4, this would be a restrictive rather than a constructive measure.

6. A National Planning Council. Such a body is very necessary as an adjunct to, or as an agency closely allied with, the office of Engineer-Consultant. Otherwise its deliberations tend to become more academic than practical. Few, if any, of the objectives set up ever get beyond the report stage.

7. Independent Engineering Departments for Each Agency. The present system needs coordination and can be greatly strengthened by better cooperation, and by more frequent interchange of facilities. Duplication of work and the desire to perpetuate itself are inherent faults of every bureau. The plan offered here aims not only to retain the flexibility and direct action of the bureau system but also to safeguard engineering operations from political manipulation, by getting the work done in the simplest and most direct way, with sufficient latitude to secure efficient and smooth functioning.

Some planners want the government to get out of business and some want the government to get into more business. The issue will depend upon the ability to keep people at work. The real problem is to foster greater cooperation between government and business, between management and labor, and within industry and government itself. The solution entails the promotion of new enterprises, the production and distribution of new facilities and appliances, the maintenance of a high standard of living. In all this, the engineer has an important role to play.

Some engineers contend that members of their profession should be satisfied with the role of executives and managers, who carry out the orders of others, and should leave the grief of public administration to politicians and other willing hands. The test of any profession is the quality of service it renders, the degree of integrity, both moral and intellectual, that it exhibits.

The way is opening up for the engineering profession to choose the path it wishes to tread—whether to go on as it is now going, submissive to the direction of more actively interested groups, or to increase the service it is especially well equipped to render. If it is to be the latter, then we must have some say in what we are to build; we must help conceive as well as design public projects, and have a voice in the public administration thereof.

Design of Built-Up Plywood Panels

An Argument for Applying Engineering Analysis to a Comparatively New Building Material

By Robert D. Scott, Assoc. M. Am. Soc. C.E.

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Growth of prefabrication in housing has greatly expanded the use of plywood panels. If this material is to be employed economically and safely, the same care should be used in the design of its structural elements as is expected in the case of steel and concrete. In this article Mr. Scott presents a concise method for designers and gives examples to demonstrate typical applications.

THE advent of prefabricated plywood housing has to some extent opened a new field of interest to civil engineers. Considerations of economy, lightness, and precision—the imperatives of successful housing prefabrication—all require that the component parts of a prefabricated plywood house be designed. Material may be wasted in the construction of a conventional house. Weight and precision may be partially ignored when a house is built in place, one building material being placed upon another, each piece being cut and trimmed as it is fitted into its final position. But in a prefabricated house, every piece of material must be utilized to afford maximum strength with minimum weight. Only an engineer can appreciate the full import of these distinctions and only his services will be able to satisfy the need thus made evident. For these reasons it is appropriate to present for the consideration of civil engineers some of the design theories thus far developed for prefabricated plywood construction.

The best statement of the fundamental theory has been given by the late John A. Newlin, M. Am. Soc. C.E., of the Forest Products Laboratory, in a pamphlet entitled *The Designing for Strength of Flat Panels with Stressed Coverings*. Prior to the publication of this pamphlet, the "structural analysis" of built-up plywood construction consisted of direct tests of each design or of simple comparisons of a particular design with specimen sections which had been tested by the Laboratory and reported in two earlier pamphlets, *Plywood as a Structural Covering for Frame Wall Units*, and *Floor Panels With Stressed Plywood Coverings*, both by George W. Trayer, of the Forest Products Laboratory. With the appearance of Mr. Newlin's contribution, however, a definite rational theory, based upon the mechanics of materials, may be generally applied to this new and progressive method of construction. The purpose of this article is to illustrate the application of Mr. Newlin's design procedure with a few practical examples.

The performance of a built-up panel, in which solid wood members of rectangular section are used as framing members, and in which plywood is used as covering, depends largely upon the behavior of the plywood (a thin plate) acting as a short column under direct stress. Thus, if a transverse load is applied to a simply supported built-up section (Fig. 1), the stresses induced in the compressive face by flexure may cause the covering material to buckle before the allowable crushing stress is developed. According to the theory of thin plates, the stress necessary to produce buckling varies inversely with the square of the width of the plate. This principle forms the basis of the plywood design procedure presented by Mr. Newlin.

The procedure consists of (1) establishing, from buckling considerations, the maximum width of the plywood panel that may safely be regarded as furnishing strength and stiffness to a built-up section, (2) computing the properties of the section, and (3) proceeding as usual to determine the fiber stresses and deflections under assumed loadings.

The maximum width of plywood panel that will furnish strength and stiffness to a built-up section is called the "basic width," and may be defined as the clear width of panel at which the direct stress necessary to produce buckling is equal to the allowable crushing stress of the plywood acting as a short column parallel to the length of the panel. In other words, a panel having a "basic width" will develop its full crushing strength just before it buckles. Since a panel of greater width would buckle before the allowable crushing stress could be developed, it is obvious that in a built-up section, only the "basic width" of the panel may be depended upon to provide strength and stiffness to the section. Consequently, in computing the moment of inertia and the location of the neutral axis, both of which are to be used in computing the fiber stresses and deflections, any width of panel in excess of the "basic width" should be ignored. The basic width for any thin plate depends upon the thickness, stiffness, and buckling stress of the material; for plywood, the basic width can be approximated by the formulas:

$$\text{For three-ply plywood, } b = 31\,h\sqrt{\frac{h}{t_1 + t_3}} \quad \ldots\ldots\ldots (1)$$

$$\text{For five-ply plywood, } b = 36\,h\sqrt{\frac{h}{t_1 + t_3 + t_5}} \quad \ldots\ldots (2)$$

in which b is the basic width of the panel; h, the total

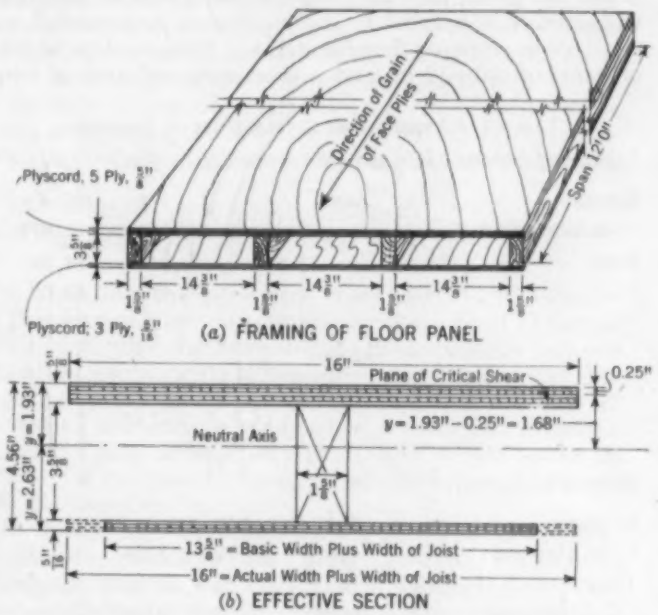
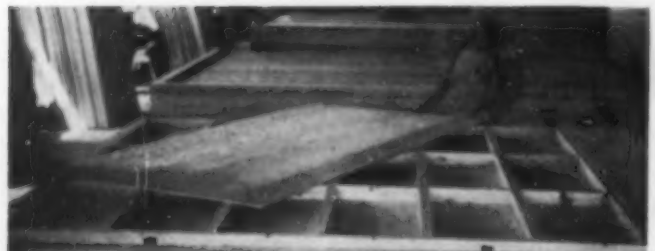


Fig. 1. Typical Built-Up Plywood Floor Panels



SHOP FABRICATION OF PLYWOOD PANELS

thickness of the plywood; and t_1, t_2, t_3, the thickness of individual plies in which the grain of the wood is parallel to the direction of stress, that is, parallel to the length of the panel.

Recently the Douglas Fir Plywood Association established standard thicknesses of plies for Douglas fir plywood (See *Technical Data on Plywood*, 1942). "Basic widths" for plywood of this species can be determined by the use of Equations 1 and 2. Of the available grades of Douglas fir plywood, the well-known "plyscord" is by far the most popular for use in stressed cover construction. Ply thicknesses and basic widths of plyscord are tabulated in Fig. 2. In the following example, the plywood covering is assumed to be of plyscord.

A built-up floor panel section, in which the joists are nominal 2-by-4's of Douglas fir, is represented in Fig. 1. The top covering is $^5/_8$-in. 5-ply plyscord and the bottom covering is $^5/_{16}$-in. 3-ply plywood of the same grade. The joists are spaced 16 in. from center to center, thus making a clear distance between joists of $14^3/_8$ in. Top and bottom plywood covers are glued to the joists.

The position of the neutral axis of the section is determined in the computation, Table I, remembering that the width of panel in excess of the basic width must be disregarded. Also, because wood has very little strength across the grain, only the cross-sectional area of the plies whose grain is parallel to the joists may be regarded as effective in resisting flexural stress. Thus, a clear width of panel of only 12 in. and a cross-sectional area of two plies are effective in the $^5/_{16}$-in. bottom covering, while full width of 16 in. (since the basic width for $^5/_8$-in. ply wood is greater than the actual width of 16 in.) and cross-sectional area of three plies are effective in th top covering. For convenience, a single unit of th whole section is analyzed in Table I (see Fig. 1, *a*).

These computations are based on the assumption th the section is homogeneous, which, of course, it is in th present case, the modulus of elasticity of the two cover ings being the same as that for the joist, that is, 1,600,0 lb per sq in. If the joists were of Western hemlock, fo example, which has a modulus of 1,400,000 lb per sq in. the section would not be homogeneous. In instance where the difference between the moduli of the plywoo and joists is great, the coverings should, theoretically a least, be transformed to equivalent areas of the same species as the joists. However, such instances will sel dom be encountered in practice since the most abundant and economically available species for joists have modul of elasticity which are either the same or nearly the same as plywood.

Now assume that the floor panel is to be 12 ft long and is required to carry a live load of 40 lb per sq ft. The dead load is about 5 lb per sq ft. The total load, or 45 lb per sq ft on the 16-in. wide section, produces a bending moment of 13,000 in.-lb.

Applying the usual formula, $f = \frac{My}{I}$:

$$f_c = 13{,}000 \times \frac{1.93}{40.7} = 615 \text{ lb per sq in.}$$

$$f_t = 13{,}000 \times \frac{2.63}{40.7} = 840 \text{ lb per sq in.}$$

TABLE I. ANALYSIS OF SINGLE UNIT OF SECTION

Location of Neutral Axis (Moments About Top Surface):

MEMBER	AREA		y	Ay
$^5/_8$-in. plywood	$16 \times {}^5/_8$	= 6.0 sq in.	0.312 in.	1.87 in.^{3}
JOIST	$1^3/_8 \times 3^5/_8$	= 5.89	2.44	14.39
$^5/_{16}$-in. plywood	$13^5/_8 \times {}^5/_{16}$	= 2.72	4.41	12.00
		14.61 sq in.		28.26 in.^{3}

$$\bar{y}_c = \frac{28.26}{14.61} = 1.93 \text{ in.}$$

$$\bar{y}_t = 4.56 - 1.93 = 2.63 \text{ in.}$$

Moment of inertia:

MEMBER	AREA	d	Ad^2	I_0	$I_0 + Ad^2$
$^5/_8$-in. plywood	6.0	1.62	15.72	0.26	15.98
JOIST	5.89	0.51	1.53	6.45	7.98
$^5/_{16}$-in. plywood	2.72	2.48	16.71	0.03	16.74
Total					40.70 in.^{4}

WORKING STRESSES FOR PLYSCORD

Are these stresses within allowable working limits? The Douglas Fir Plywood Association's handbook, *Technical Data on Plywood*, indicates that plyscord, if placed in flexure by itself, may in dry locations be safely stressed to 1,875 lb per sq in. in extreme fiber, while in compression parallel to the grain, it may safely be stressed to 1,375 lb per sq in. In the built-up floor panel, however, the plyscord coverings are subjected to one type of stress only—either tension or compression—and the amount of stress which will be safely supported by the material depends, as has been pointed out, on the

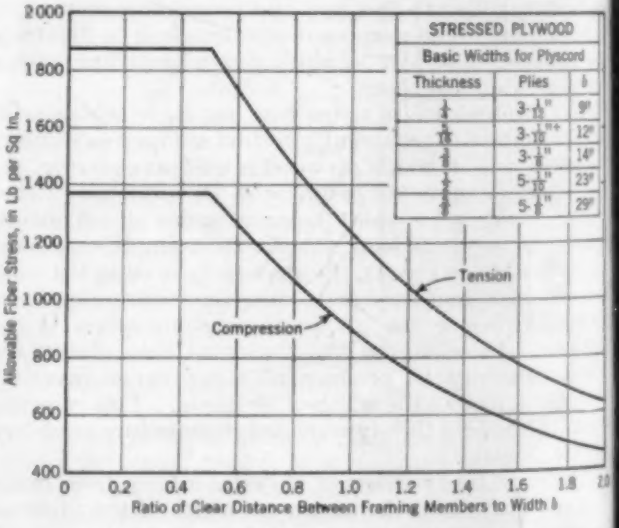


FIG. 2. RELATIONSHIP BETWEEN FRAMING ARRANGEMENT AND ALLOWABLE FIBER STRESSES FOR PLYSCORD

dency of the plywood to kle. This buckling tend- y depends, in turn, upon ratio of the actual width be- en framing members to the sic width" of the plywood. An adaptation of the general ve of working stresses mmended by Mr. Newlin iven in Fig. 2. The curves resent the allowable work- stresses for plyscord for ratio of joist spacing to ic width between zero and When the ratio of actual dth to the basic width is ater than 2, the section can- be regarded as stressed er construction, which is to that the space between ming members is so great t the covering material is able to contribute either ength or stiffness.

To illustrate the use of the rves, the tension covering the built-up panel just dis- sed has a ratio of actual dth to basic width of $\frac{14^3/_8}{12}$, 1.2. The compression

A PREFABRICATED HOUSE NEARING COMPLETION

vering has a ratio of $\frac{14^3/_8}{29}$, or 0.495. The correspond- working stresses for these ratios, taken from the rves, are 1,030 lb per sq in. in tension and 1,375 in com- ession. The floor panel is, therefore, adequate as far bending stresses are concerned. Since the stresses in extreme fiber are less than the allowable stress for uglas fir, it is unnecessary to compute the actual stress the joists. In some instances, however, it may be cessary to make such a computation, since the joists y be overstressed even though the covering plywood is t. This may occur in designs in which Douglas fir ply- od is used with joists of a relatively weak species.

SHEARING RESISTANCE

The critical shearing plane in the section is the glue nt between the two bottom plies of the top plywood. e glue joint between the joist and the plywood is, of urse, nearer the neutral axis of the section. There the earing stress will be greater than at the next glue joint ove, that is, between the two bottom plies of the com- ession plywood. However, it will be noted that at the nt between the joist and the plywood, the grain of the od of the joist is parallel to that of the plywood, thus oducing a joint which, according to reported tests, is as ong as the wood itself.

At the joint between the two plies just above the joist, e grains of the joining plies are perpendicular. The rking stress in shear for a glue joint between parallel ains is equal to the working stress in horizontal shear the wood. A working stress of one-half this amount recommended for a joint in which the grains of the ning pieces are perpendicular. The Forest Products boratory recommends that the allowable shearing ess for a joint of the latter type be reduced still further the joint is at any outside or marginal joint of a stressed er panel. In such a case, the allowable stress in shear equal to one-fourth of the allowable stress for wood. ee *Technical Data on Plywood*, previously mentioned.)

Next the shear between the two bottom plies of the compression plywood will be investigated. The statical moment of the effective area above the critical plane is:

$$Q = A\bar{y} = {}^3/_8 \times 16\ (1.93 - 0.25) = 6.72\ \text{in.}^3$$

The total shear resulting from a load of 45 lb per sq ft on a width of 16 in. is $45 \times {}^4/_3 \times 6 = 368$ lb. Unit shear is computed from the familiar formula,

$$v = \frac{VQ}{Ib} = \frac{368 \times 6.72}{40.7 \times 1.63} = 37.3 \text{ lb per sq in.}$$

Since the allowable stress in horizontal shear for Douglas fir is approximately 90 lb per sq in., the allowable stress for the joint investigated is one-half as much, or 45 lb per sq in., and the joint is therefore not overstressed.

Deflection may be determined by the usual formula, using a modulus of elasticity of 1,600,000 lb per sq in. For the floor panel, the deflection under live load only is

$$d = \frac{5Wl^3}{384EI} = \frac{5 \times 40 \times 12 \times \overline{12 \times 12}^3}{384 \times 1{,}600{,}000 \times 40.70} = 0.38 \text{ in.},$$

which is within the usual limit of $L/360$.

These are theoretical considerations. Civil engineers will realize that the foregoing discussion covers but one phase of prefabricated housing design; and that the vagaries of manufacture, distribution, and erection all have their influence on the finished house. Mr. Newlin's pamphlet lists several empirical rules which must be followed if the manufactured panel is to follow the theory just discussed.

It should also be realized that new and better prefabrication practices are being evolved constantly. When the present war ends, the prefabricated plywood housing industry should undergo a development that will make it exceedingly attractive to the civil engineering profession.

Basic Hydraulics of Water Storage Projects

II. Turbine Settings

By GEORGE R. RICH, M. AM. SOC. C.E.

CHIEF DESIGN ENGINEER, TENNESSEE VALLEY AUTHORITY, KNOXVILLE, TENN.

OF great advantage when preparing economic studies of turbine runners is the use of specific speed charts. Such charts are of little use unless performance of the test model at several draft heads is plotted. As Mr. Rich points out, there have been few basic changes in the installation of turbines for moderate- and higher-head plants, but many economies in the lower-head range have been effected through simplification of layout. This article is the second in a series presented as a single paper before the Hydraulics Division. A third is planned for a succeeding number of "Civil Engineering."

ON the subject of turbine settings, my perspective is that of the purchaser's engineer. To avoid ambiguity in the waterwheel specifications and to insure truly competitive bidding for turbines, the purchaser's engineer must establish not only the head and power but also the elevation of the runner with respect to tailwater, the speed of rotation (which amounts to the same thing as specific speed), and the unit spacing. In making these determinations, he will of course enlist the advice and cooperation of the turbine manufacturers but, as will be argued subsequently, these particular features are intimately related to the overall economic design of the particular project and cannot be delegated.

This is particularly important in cases like the Watts Bar project (Fig. 1), in which the power station acts as a dam. The rightful and exclusive domain of the manufacturer's engineer is the determination of the design of the turbine runner and its accessories, including as an essential feature the hydraulic layout and proportions of the scroll case and draft tube. In this work the manufacturer's engineer will of course incorporate the structural preferences of the purchaser.

As a means of emphasizing the fact that no two installations of the same head and power will necessarily—for overall optimum project economy—have the same specific speed (or speed of rotation) and the same elevation of runner with respect to tailwater, I have prepared the exaggerated comparison shown in Fig. 2, from which I believe it will become apparent that turbine settings designs must be tailored to the particular project and cannot be established by blanket statistical methods. For the same head, the same power, and the same margin of safety against cavitation, a relatively deep setting with respect to tailwater means more expensive structures but a higher operating speed, smaller physical dimensions, and lower costs for turbines and generators, and relatively less WR^2 required for a given degree of speed regulation. On the other hand, a relatively shallow setting means less expensive structures but a slower operating speed and larger physical dimensions and costs for the generating units. In cases where the additional capacity is utilizable, the larger diameter of turbine will have the advantage of greater value at peak load during periods of head reduction made necessary by floods. Generally speaking, where bedrock is at relatively low depth, the natural selection is the smaller-diameter, higher-speed wheel, and conversely where it occurs at higher levels.

One of the most common fallacies in making comparative economic studies of wheel settings for a given installation, with fixed head and power, is to prorate the unit spacing and all draft-tube and scroll-case dimensions according to the rules of homologous relations in proportion to the various alternates in wheel diameter. This procedure has its rightful place in stepping up a smaller member of a given family of turbines for an entirely new project of different power,

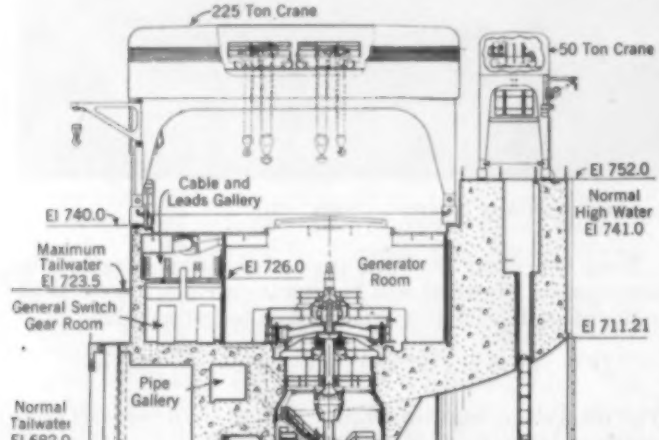


FIG. 1. WATTS BAR POWER HOUSE SETTING WITH KAPLAN PROPELLOR-TYPE TURBINES

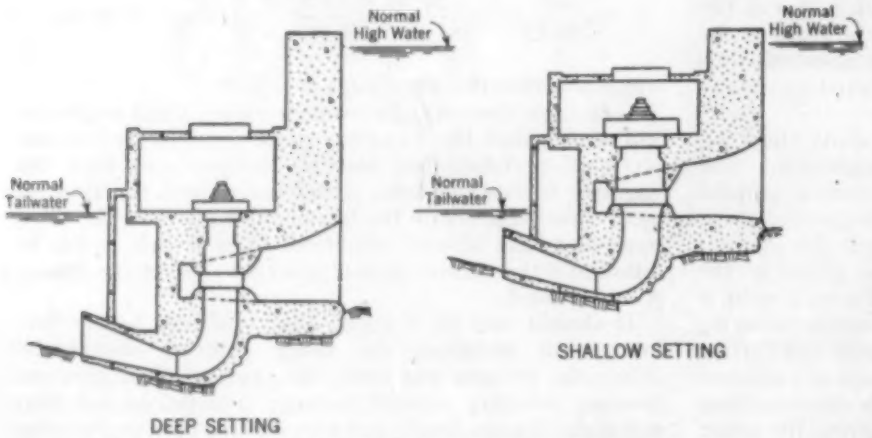


FIG. 2. COMPARISON OF DEEP AND SHALLOW TURBINE SETTINGS

FORT LQUDOUN PROJECT, A LOW-HEAD, MULTIPLE-SERVICE UNIT OF THE TVA SYSTEM

but the area of water passages and the unit spacing for any given job, with established head and power, are fixed simply by the permissible head losses at entrance and exit that are established once and for all as acceptable. These losses are in the order of about 0.25 ft at the intake and 0.80 ft at the exit from the draft tube. In varying the diameter and speed of runner with the draft head at a given project to obtain the economic combination, it is only necessary to make local adjustments of the waterways in the immediate vicinity of the runner.

The interdependence between these pertinent factors is implied in the modern method of presenting so-called "experience curves" (Fig. 3); and perhaps one of the most significant features of turbine-setting design in the last ten years is the more widespread appreciation of the pertinence of sigma in any consideration of specific speed versus head, and of the fact that any older-type single experience curve not showing this factor is of very limited usefulness in preparing basic economic studies. This change in attitude is often loosely expressed by saying that "specific speed does not mean much any more."

For example, from Fig. 3 it is evident that for a head of, say, 40 ft, involving the use of a propeller runner, a variation of 10 ft in draft head means a difference of between 145 and 170 in specific speed. By the same token for a Francis turbine operating at a 90-ft head, a variation of 15 ft in draft head means the difference between a specific speed of 60 and 75. Several years ago, when the possibility of such latitude with respect to selection of draft head was not so generally understood, it was common to think of specific speed as affording a rather positive identification of a particular family of homologous runners, each rigidly associated with a particular head. In modern practice, however, this variation of 15 rpm in the specific speed of Francis units might be represented by the same set of basic model tests. With respect to propeller runners, a single set of model tests applies to a much more extended specific speed range.

Perhaps it is not going too far to say that the greatest advantage of using the specific speed designation today is that it facilitates the condensation of data into charts, the principal value of which is in preparing comparative economic studies at the inception of a large development. After preliminary studies indicate rather definitely the trend of setting design, it is of course essential to use the manufacturer's actual cavitation break-point model-test curves (Fig. 4) for the particular runner selected. It is likewise essential to insure, as studies progress, that the unit speed, or what amounts to the same thing, the peripheral coefficient of the runner, lies very close to the cen-

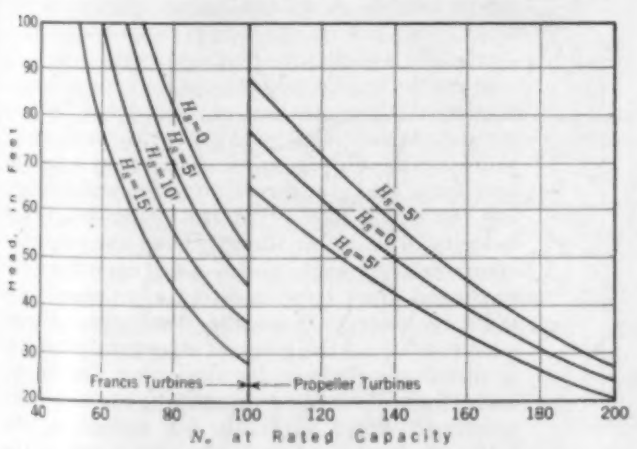


FIG. 3. TURBINE-SETTING EXPERIENCE CURVES, FROM *Handbook of Applied Hydraulics*, BY C. V. DAVIS

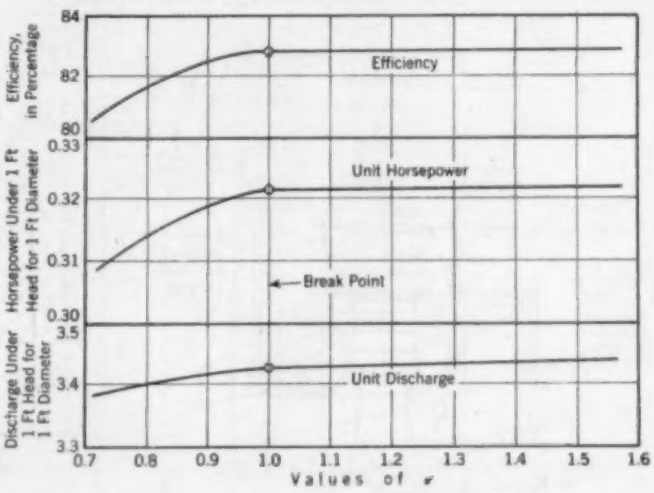


FIG. 4. CAVITATION MODEL-TEST CURVES FOR CHICKAMAUGA TURBINES, FOR ONE GATE OPENING AND BLADE ANGLE

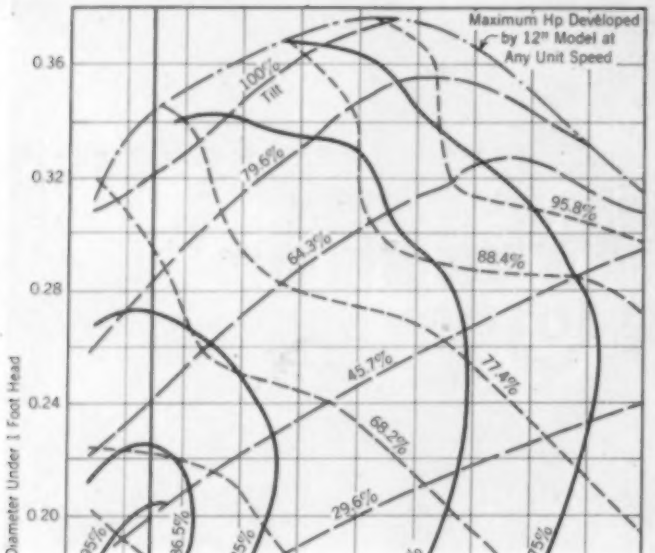


FIG. 5. PERFORMANCE CURVES STEPPED UP FROM TEST OF 16-IN.-DIAMETER MODEL OF CHICKAMAUGA TURBINE, RATED AT 36,000 HP, 36-FT HEAD, 52-FT MAXIMUM HEAD

tral efficiency contour of the so-called "oak-tree" test curves. (See Fig. 5 for Chickamauga model curves.)

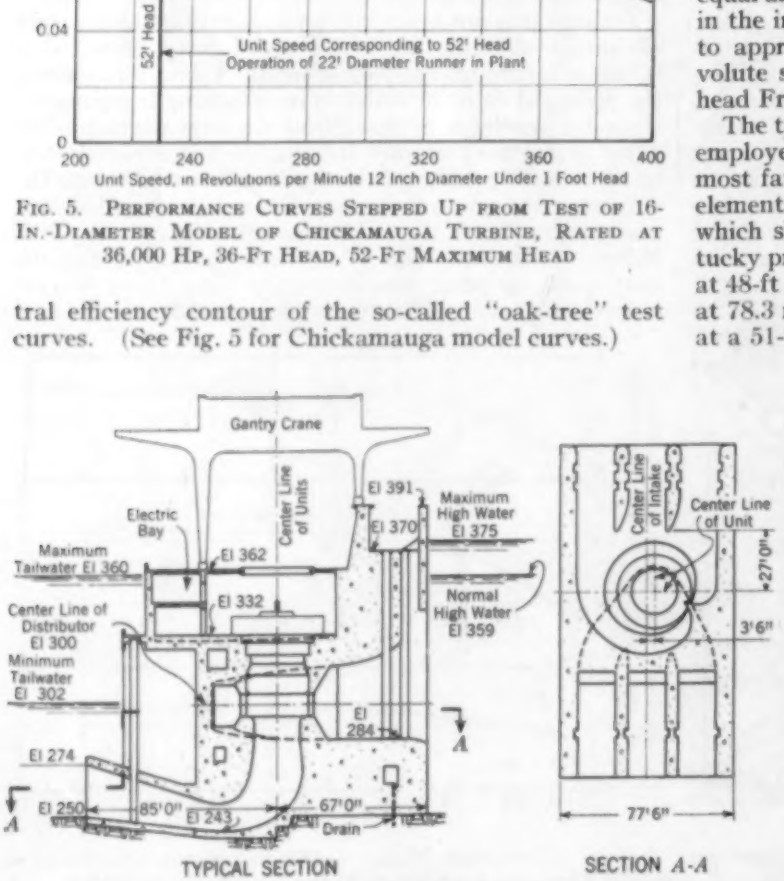


FIG. 6. POWER STATION AT KENTUCKY PROJECT

An exceedingly interesting study involving the factors just discussed was recently made by the TVA organization in connection with a projected large international development for an operating head in the vicinity of 90 ft. The sponsors of the project wished to explore the economy of adopting propeller-type instead of Francis runners. While investigations in collaboration with the manufacturers indicated that such advanced development might be physically possible, on the grounds of overall economy it was found not to be justified. In addition to all the considerations enumerated, a further factor developed: The anticipated economy due to increased normal operating speed was canceled by the expense of accommodating runaway speeds, the propeller-type wheel having a runaway speed in the order of three times normal, while the runaway speed for the Francis-type wheel is about twice normal.

To the writer's knowledge, there have been few substantial changes in waterways for moderate-head and higher-head Francis turbine installations in the last decade, but there is definitely a marked tendency in low-head concrete substructures to adhere to simple, rugged outlines. Waterways of rectangular cross section, readily conducive to forming, and free from island construction in the intake or splitters in the draft tube, are generally used. Major economies in plant layout and construction invariably accrue from keeping contraction joints between units in a single plane, at right angles to the longitudinal axis of the power station, and from preserving unbroken the alinement of the main piers, which afford the principal elements of structural stability. Not only are such designs most economical from the standpoint of design and construction, but in addition they are shown by comparative model tests at manufacturers' laboratories to have operating efficiencies that at least equal any results thus far attained by island construction in the intake, or by refinements in curvature of surfaces to approximate the action of the standard plate-steel volute scroll cases customarily employed for moderate-head Francis units.

The type of overall power-station design now generally employed for lower-head installations represents the most favorable combination of structural and hydraulic elements. Such an installation appears in Fig. 6, which shows sections of the power station at the Kentucky project. The Kaplan turbine is rated at 44,000 hp at 48-ft gross head, with a tailwater elevation of 305 ft and at 78.3 rpm. It has maximum efficiency and best speed at a 51-ft head. The head losses in the intake and draft tube are 0.25 ft and 0.80 ft, respectively. There are no islands in the intake, no splitters in the draft tube, and no attempt is made to simulate steel plate volute scroll-case construction.

Since the intake velocities in the typical lower-head installation are low, of the order of 2 or 3 ft per sec, the resulting head losses are small, and a short intake affords ample distance in which to accelerate and give direction to the water entering the scroll case. On the other hand, the velocity of water at the exit from the runner is comparatively high, and a long, carefully proportioned draft tube is essential to regain the requisite energy from the discharge. Under such conditions the greatest structural economy is obviously realized by designing the intake and draft tube as a monolith, making their combined mass available for sustaining the reservoir overturning load, and locating the electrical bay on the downstream side of the generating units.

Engineers' Notebook

Suggestions and Practical Data Useful in the Solution of a Variety of Engineering Problems

Circular Reinforced Concrete Footings

By ROBERT W. ABBETT, M. AM. SOC. C.E.

STANDARD methods for designing reinforced concrete column footings have been followed in general practice for many years. In all but rare instances only square, rectangular, and continuous footing slabs reinforced in two directions are considered. It has been recognized that the method of reinforcing square slabs is not in accord with the actual distribution of stresses. Actually, bending stresses in footing slabs are distributed along radial and circumferential lines with respect to the column load. When the slab deforms under load the tendency is for the corners to curl upwards, transferring additional bearing pressure to the inner region of the slab.

The most natural form for a spread footing as far as stress distribution is concerned is circular in plan with radial and circumferential reinforcement. A circular footing could be constructed as easily and as economically as a square one in soils where concrete can be poured without forms, directly in the excavation. The amount of concrete required is about the same as for the square type, but the amount of reinforcing steel may be somewhat less. Any difference between the way in which the two types transmit pressure to the soil will be in favor of the circular design.

The stresses in a footing slab cannot be determined exactly from statics, and the solutions from the theory of elasticity are difficult and tedious. Furthermore, the usual calculations based on the theory of elasticity as applied to thin plates are not indicative of actual stress conditions when the thickness of the slab is large in comparison with its radius.

An approximate method is proposed for circular slabs which follows the present standard design procedure for square footings with the exception of the calculation of the bending moment and the arrangement of reinforcing steel. The slab is assumed to be cantilevered out in all directions from the column perimeter. The bending moment thus produced will determine the radial reinforcement required. The circumferential stress is assumed to be relatively small in a stiff slab and will be resisted by circumferential reinforcement placed more or less arbitrarily and used primarily as spacer bars for the radial reinforcement. A round column is assumed. In the case of a square column, moments may be computed on the basis of a round column of equivalent area.

The total bending moment around the perimeter of the column (Fig. 1, *a*) produced by the bearing pressure on the bottom of the footing, is given by

$$M = p \int_0^{2\pi} \int_c^R x(x - c)dx\, d\theta$$

Integrating this equation between the limits shown, and letting $c/R = a$ gives

$$M = \frac{\pi p R^3}{3}(2 - 3a + a^3) = \frac{PR}{3}(2 - 3a + a^3) \quad . \quad . \quad . \quad (1)$$

in which P is the total column load transmitted to the footing; p, the unit load; and R, radius of footing.

This equation for the total bending moment may be considered roughly analogous to a corresponding equation for the total bending moment in a square panel of a flat slab floor:

$$M = 0.125\, Wl\left(1 - \frac{2}{3}\frac{c}{l}\right)^2 \quad . \quad . \quad . \quad . \quad . \quad (2)$$

in which W is the total load on the panel; l, the length of one side of the square panel; and c, the column radius.

Equation 2 neglects the effect of Poisson's ratio in a material stressed in two directions and gives bending moments that are considerably larger than those actually produced. Numerous tests on full-size panels have determined the actual moments to be about 28% less than the computed values. Most specifications recognize this difference by allowing moments to be determined by

$$M = 0.09\, Wl\left(1 - \frac{2}{3}\frac{c}{l}\right)^2 \quad . \quad . \quad . \quad . \quad . \quad . \quad (3)$$

Since the stress conditions under the column in a circular footing are very similar to those in a flat slab floor

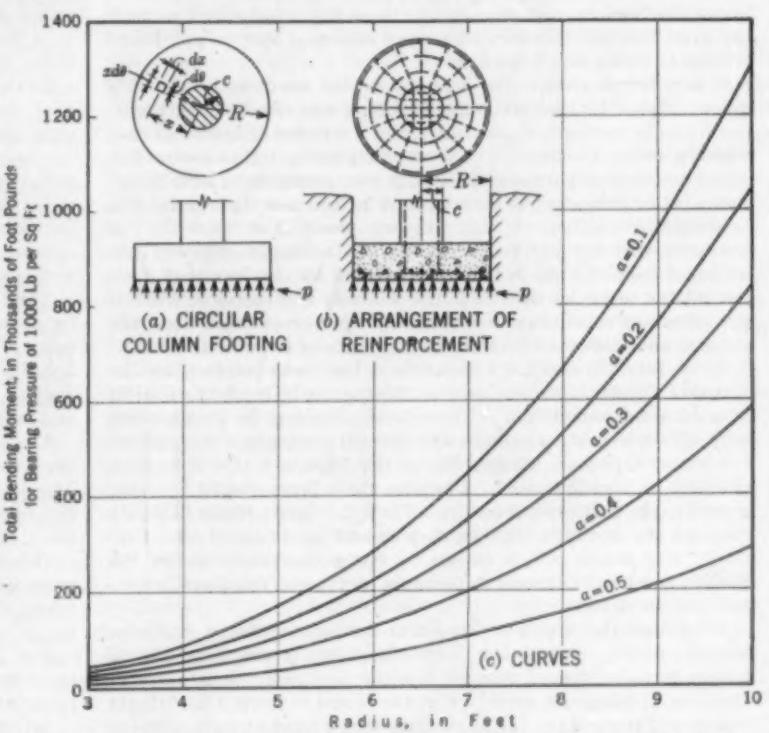


FIG. 1. GRAPHICAL SOLUTION FOR MOMENTS IN A CIRCULAR FOOTING

over the column, it is reasonable to assume that moments computed by Eq. 1 are also larger than those actually produced by approximately the same percentage. Applying this reduction, the equation for the bending moment in a circular footing becomes, approximately,

$$M = \frac{PR}{4}(2 - 3a + a^3) \quad . \quad . \quad . \quad . \quad . \quad . \quad (4)$$

Equation 4 is solved graphically in Fig. 1 (*c*) for the usual range of values of a and R and for a soil bearing pressure of 1,000 lb per sq ft.

Figure 1 (*b*) indicates one method for placing the radial reinforcement. In the case of large footings it would not be necessary to extend all bars out to the edge of the footing. Such shorter bars could be furnished by bending column dowels into the footing slab the required distance. This would also serve to reduce some of the eccentric bends and also excessive overlapping of bars under the column.

For heavy loads and low bearing pressures, stepped footings will be economical. In this case, the bending moment in the lower slab should be computed around the perimeter of the upper step in a manner similar to that used for computing the moment around the perimeter of the column, using the radius of the step instead of the column in computing the value of a.

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Board Action Criticized—and Defended

DEAR SIR: In regard to the recent interpretations and/or modifications of the Atlanta action of the Board of Direction, on collective bargaining, I have heard the view expressed by some members that the pill is now sugar coated and therefore somewhat easier to swallow. However, a careful study of the suggestions and interpretations reveals that nothing of any significance has been changed. The aims are still the same, and it appears that the only modifications are those which have been deemed advisable to evade the application of Federal law and also the laws of New York relating to "labor organizations." Therefore, let no one be deluded into believing that the collective bargaining groups (or unions) are to be entirely divorced from the Society, or that any important changes have been made from the original action.

Although it is obvious, it appears necessary to make the explicit statement that the Society is composed of its Local Sections and, conversely, that the 64 Local Sections comprise the Society. Hence, the policies and actions of every Section affect every member of the Society, and already the press has stigmatized us with the word "union" to which we cannot object as long as any Local Section is acting as a little union.

It is still true that in this country no one needs to belong to a union. Space limitations preclude a long and detailed argument, but it has been clearly demonstrated in a number of instances that where a union threatens to assume bargaining rights for professional men it is only necessary for such men promptly to form themselves into a group and protest against inclusion of their group in a heterogeneous union. If any engineer wants the "benefits" of unionism, why not let him join a union? Insistence upon our own union, it seems to me, is largely prompted by the fear that if we join a labor union we shall be in the minority and therefore will not get monetary returns greater (in the proper proportion) than the artisans and tradesmen forming the majority of the union.

As of July 15, about 1,015 petitions had been received by the Board of Direction requesting that this matter be made the subject of a national referendum. These were obtained by circularizing only 4,500 corporate members, and are still coming in. Also, about 150 letters expressing disapproval of the Atlanta action have been received by Headquarters. I believe these facts should be made known to the entire membership. The letters and petitions already received are so numerous that they cannot be shrugged off. Certainly any action which causes so much dissension within the Society can hardly be said to promote unity, and must surely contain serious defects.

Why does the Board of Direction not admit that it made an honest mistake, and seek to undo the harm it has done and to restore us to our former enviable position as a professional society? One way of doing this would be for the Board to rescind its Atlanta action and request the Local Sections which have already adopted it to do likewise. I believe that a number of the Sections which followed the example of the Board of Direction might be willing to rescind their action now if the Board did so first. Those Sections which persisted in their unions and valued them above their professional society could then be banished from the Society.

At the very least, the Board of Direction can hardly refuse to submit this matter to a national referendum as the subject of a proposed amendment to the Society's Constitution.

JOHN H. PORTEUS, Assoc. M. Am. Soc. C.E.
Upper Darby, Pa.

DEAR SIR: Commenting on the ideas expressed by Mr. Porteus, the Local Section is not only a component part of the Society; it is autonomous within its own area and within the limits imposed by its constitution. Thus the policies of Local Sections may differ, one from another, and may also differ from the recommendations of the Board of Direction. The Board could not, and did not desire to, compel Local Section compliance with its recommendations anent collective bargaining. It follows that no Local Section has the right to, or can, commit the Society as a whole to any course of action.

In final analysis, a Local Section of the Society has little, if anything, to say about whether or not its employee members form a collective-bargaining group. Employees of all classes are guaranteed that right by law, and interference with expression of that right by employers is contrary to law. What the Board has done is (1) to place the Society or its representative in the position of *amicus curiae* in order to bring the Society influence to bear when it is desirable and necessary to establish the professional status of an engineering employee; and (2) to assist groups which may form for collective-bargaining purposes to do the job professionally and well, and to avoid some of the pitfalls that beset the inexperienced.

The Board is well aware that the present situation, as evidenced by protests to its collective-bargaining proposals, does not imply unity; but it is equally well advised that to attempt to refuse Local Sections or professional engineering employee members of the Society the right to organize in defense against inclusion in trade and labor unions, would be strenuously opposed.

The writer has received a number of unsolicited letters expressing satisfaction in whole or in part with the Board's Atlanta decision. This is unusual; nearly always such letters are left unwritten while the opponents of an action, not the proponents, air their views. Some of the letters received have contained excellent constructive criticism which is most acceptable to the Committee on Employment Conditions and, it is the writer's belief, to the Board. Certainly it cannot be inferred, by even the most ardent proponent of the Board's action with respect to collective bargaining, that the course of procedure adopted is either perfect or final. Assistance in arriving at a better solution should be the objective of every Society member.

Mr. Porteus' letter—with the somewhat lurid references to "our own union" and a Local Section "little union"; the unfair inno-

doubts cast upon the character and courage of engineering employees forced into the position of having to join non-professional groups; the naive statement that our Society members are adequately protected against invasion by non-professional unions; and the totally unwarranted and somewhat hysterical reference to banishment of certain Local Sections from the Society—is neither conducive to the promotion of unity nor is it helpful to the Society, its officers, and members.

A. M. RAWN, M. Am. Soc. C.E.
Chairman, Committee on Employment Conditions

Los Angeles, Calif.

Tennessee Valley Engineers Deal with Collective Bargaining

DEAR SIR: As president of the Tennessee Valley Section, which has become quite prominent in the collective bargaining situation, I am submitting my view on this controversial question.

Reluctance of the older members to see the Society step out in what appears to them a radical program is readily understandable. Certainly when I was with the late Ralph Modjeski and again with Arthur E. Morgan, I would have felt the same; but in a large organization such as the TVA entirely different conditions prevail, even under the leadership, during the early years, of an engineer of Dr. Morgan's breadth.

Early in its history the need was felt for some sort of an organization of younger engineers—at first only for purposes of acquaintance and friendship, which could not be obtained through the diversified Founder Society meetings. And this organization, known as the Tennessee Valley Authority Engineers Association, became intensely popular. Soon young engineers found in this Association means of expressing themselves concerning all kinds of matters, not only technical but also affecting their welfare and working conditions; it could discuss their problems with management and obtain desirable results on such details as leave regulations, and air-conditioning of drafting rooms. Then the Association began to discuss larger questions, such as salary and job classification, and became recognized as a bargaining agency in much the same way as craft unions are recognized on construction work. This growth required some eight or ten years to materialize.

When war industries brought in large numbers of engineers to this area under working and living conditions far from ideal, they felt the need for an organization, and the technical organization of the A. F. of L. moved in at once to take advantage of this need. In such a situation the young engineer without any means at his disposal to combat the social forces with which he was confronted found himself entirely helpless.

Fortunately the Society had been awake to this situation for many years and its Committee on Employment Conditions, as outlined in the July issue, had worked out a solution. Due to this fortunate circumstance and the direct action taken by the Board of Direction at its Atlanta meeting, an organization for professional engineering employees was formed in the Tennessee Valley.

This organization immediately found itself at grips with the A. F. of L., and has fought to maintain its stand that professional men should have an organization composed only of professionals and governed by professional engineers of their own choosing. Through the action of this professional group, such serious problems as a strike threat (in the form of a strike ballot requested of the War Labor Board by the A. F. of L. group and then cancelled the day before the ballot was to be taken) and similar difficulties were averted in a large Government war plant being constructed in the Valley.

Fortunately the Board was progressive enough to realize that collective bargaining is a problem which cannot be ignored and must be met, and was aggressive enough to take definite action by which we could form a collective bargaining unit and take care of the interests of our younger engineers. To me it is entirely fitting that our Society, oldest of the Founder Societies, should thus be ahead in this social venture. It is the young engineer in whose hands the welfare of the Society must necessarily be placed within the next few years, when the older ones pass on. Just what the future will bring—whether the Society will get deeper into the collective bargaining business or, having set up independent units, will withdraw entirely—remains to be seen; but in any event our Board is to be thanked for being progressive enough to take care of one of the most important problems that has faced our profession.

HARRY WIERSEMA, M. Am. Soc. C.E.
Assistant to the Chief Engineer
Tennessee Valley Authority

Knoxville, Tenn.

Highway Not Desired by Majority of Latin-Americans

DEAR SIR: In the April issue there is an article by B. W. Belyea, entitled "Commercial Use of Inter-American Highway."

Like many writers on this subject, Mr. Belyea ignores the fact that there is little or no commercial intercourse between the various countries of Latin America, nor in spite of the construction of this highway is there likely to be. The commerce of these countries is from the interior to the seaports and from the ports to the interior. The highways and railways should be planned on the basis of this fact and not on an abstract theory.

All the countries of Central America and Mexico produce more or less the same kind of things. They want little from each other. They ship their products—coffee, mahogany, bananas, cocoa, sisal, and so on—to North America and Europe through their seaports, and they import manufactured goods, steel, textiles, and other things. These countries will not burden themselves with costs of maintenance unless the highway, as in Guatemala and El Salvador, serves a local purpose. Why should they?

As for feeder roads, there has been a railway throughout the length of Guatemala and El Salvador for many years, and feeder roads were not built except in a few instances. The highway was built parallel to the railway because the railway ran through the principal cities, and so the highway was run through these same cities.

As a means of access to the Panama Canal the highway, when finished, will be of little value. The sooner we get over the idea that the mission of the United States is to help the peoples of all the world, the better they will like it and us.

FRED LAVIS, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.

Maintenance Desirable for Timber Joints

TO THE EDITOR: In connection with Mr. Hogue's article, in the July issue (page 299), it is well known that maintenance is needed for timber structures that are erected with green lumber. However, the effect of neglecting such maintenance has not been adequately investigated.

We recently tested six specimens to determine the effect of loose bolts. Each specimen had four split rings and five members—two 2 by 6-in. vertical outside timbers, two 3 by 8-in. horizontal intermediate timbers, 2 ft long, one 3 by 6-in. vertical center timber—and $^3/_4$-in. bolt and malleable washers. Three specimens had the rings at the centers of the 3 by 8-in. members, while three had the center rings 6 in. from the ends of the 3 by 8-in. members. The specimens were fairly well seasoned and unchecked and were kept together in a small closed space for about a week before testing.

Two specimens were tested with nuts snug, two with nuts backed off $^1/_8$ in. and well shaken, and two with nuts backed off $^1/_4$ in. and well shaken. Considering the fact that the rings were in heterogeneous positions, the tests were remarkably consistent at the time of core shear. The load was applied at about 0.05 in. per min., and the loads at core failure were roughly in the ratio of 1.0, 0.90, and 0.80, respectively, for the snug, $^1/_8$-in. off, and $^1/_4$-in. off tests for symmetrical specimens, and 0.87, 0.80, 0.74 for the unsymmetrical specimens.

The results of these tests should not be extended to unrelated specimens. It is evident that the need of maintenance is definitely indicated, although poor maintenance should not ordinarily produce failure in adequately designed joints.

CHARLES MACKINTOSH
Structural Engineer, Mackintosh and Mackintosh, Engineers

Los Angeles, Calif.

Record of Society Member and War Veteran an Inspiration

TO THE EDITOR: The local press has featured a recent reunion of three injured veterans of the first World War. Since one of this heroic trio—C. A. Stimpson—is a member of the Society, readers of CIVIL ENGINEERING may be interested in a few words about him. Mr. Stimpson—"Joe" to everyone in our organization—came to work in our office in 1914. He was a good man in the field, and we missed him when he entered the Army at the outset of the war.

He was seriously wounded, lost an arm, and had to stay in a hospital in France for more than a year. When he finally came back he was a physical wreck and utterly discouraged. In 1925 we made him come back to our organization, and he has been there ever since. He is one of the best men I have ever had at any library study, or statistical analysis, and the real author of many of my best reports.

In spite of his physical disabilities "Joe" drives far more expertly than the average person, and has been over our Mid-West territory many times. A few years ago I had to make a train in Cincinnati—got word after the last train for there had left. "Joe" drove me the 250 miles, and we got in ahead of the train I had missed.

It seems to me the facts of such a physical and mental comeback ought to be of more than passing interest today when so many young men are returning, ill and wounded, from another war.

HENRY E. RIGGS, Past-President
and Hon. M. Am. Soc. C.E.

Ann Arbor, Mich.

Clemens Herschel—Venturi Meter

DEAR SIR: With regard to Clemens Herschel's development of the Venturi meter, I came across interesting evidence some years ago when writing a biography of the late Dr. W. C. Unwin, Hon. M. Am. Soc. C.E. His friendship with Herschel extended over many years.

Amongst Unwin's papers was a holograph letter from Herschel. It seems that Herschel had been in communication with Unwin on the subject of metering earlier, as the letter is marked as being in reply to one of May 18, 1888. The letter, the original of which is preserved in the Unwin Library at the City and Guilds College, South Kensington, London, is dated "Holyoke, Mass., June 5, 1888," and reads

"Since writing you I have tested, though rather crudely, a one-inch Venturi Meter, under 210 feet head. It works all right. I am now satisfied that here is a new and pregnant principle to be applied to the art of gauging fluids, inclusive of fluids such as compressed air, illuminating or fuel gases, steam, etc. Further, that the shape of the meter should be trumpet-shaped in both directions; such a meter will measure volumes flowing in either direction, which in certain localities becomes a useful attribute. The form of piezometer connection originally used by me at the venturi or throat alone, should be used at either end of the main-pipe (where it joins the meter) also. Any parts projecting into the meter or pipe are objectionable, on account of foreign bodies catching upon them. Such a meter will cost extremely little in comparison with the Deacon or any other, volumetric or differential. And we are but in the beginning of the art of measuring pressures and differences of pressures. When these shall be delicately measured, the Venturi Meter will have become as delicate in its lower limits of capacity as any other and it is on this score alone that it is as yet inferior to some of the volumetric meters.

"I am very grateful to you for having sent an abstract of your paper to the Secretary Inst. C. E. for publication. You will find a description of the recording gauge, recording differences of pressure, in my application for an English patent, filed 17th April, 1888."

His reference (third sentence) to "a new and pregnant principle" shows that Herschel claimed to have established a new principle by his experimental work. Later in the letter when Herschel referred to the instrument by its name, Venturi Meter, he used capitals. Evidently he contemplated adopting the name of Venturi to designate the primary essential detail of his meter in a way analogous to that in which the names of famous electricians of the past have been transferred to electrical units. Naturally a meter which depended upon the employment of a venturi as its principal feature would be described as a Venturi meter, as a valve which depends upon a sliding plate or sluice for cutting off the flow is described as a sluice valve. Though he established the principle and the name of the meter, Herschel did not succeed in ousting the very natural engineering term "throat," for the part joining the two "trumpet-shaped" portions of the meter.

A legible reproduction of the original letter is included in *The Life and Work of William Cawthorne Unwin*, a copy of which is in the Engineering Societies Library.

E. G. WALKER, M. Am. Soc. C.E.

London, England

Repairs on Gouin Dam

DEAR SIR: I have read with interest Mr. Graham's article on the repairs to the Gouin Dam in the April issue of CIVIL ENGINEERING. In particular my attention was attracted to the statement (on page 148) that asphalt plastic compound was used in a certain way.

I would like to ask whether or not this asphalt plastic compound was emulsified asphalt mastic—that is, something like a 60% water and 40% asphalt emulsion? I would also like to ask if any admixture was used in the gunite, such as emulsified asphalt containing from 15 to 20% asphalt and the rest water?

It was also noted that an admixture was used in the concrete placed on the upstream surface and the top of the dam to prevent "setting" cracks. Was this admixture emulsified asphalt mastic, and what were the proportions of sand, cement, and so on? What time of year was the work done?

The article constituted a very interesting story of an unusual way of building up the surface of a dam or other concrete structure, which has disintegrated to some extent.

C. E. HOWELL
Ebasco Services, Inc.

New York, N.Y.

Forum on Professional Relations

CONDUCTED COLUMN OF HYPOTHETICAL QUESTIONS WITH ANSWERS BY DR. MEAD

In this issue Dr. Mead gives his answer to Question No. 24, which was announced in the July issue of "Civil Engineering." The question states: "A young engineer accepts a position with a practicing engineer whom he does not know very well. After a short time he discovers that his employer is dishonest, although he has never asked the young engineer to engage in any crooked action himself. Should the young engineer retain his job?"

The writer believes it is undesirable for a young engineer to associate with a man who is dishonest in his work. It should be remembered, however, that a young engineer may not be fully capable of understanding the actions of his superior and may draw wrong conclusions from inadequate knowledge. Should he become fully convinced that his employer is dishonest, it would seem to the writer desirable that he should seek o her employment as early a practicable. Should he be asked to do dishonest work, he should of course resign his position at once.

DANIEL W. MEAD, Past-President and
Hon. M. Am. Soc. C.E.

Madison, Wis.

Question No. 25, which was given in the August number, will be answered in the next, or October, issue. Next in the series the following question is announced. Replies may be received until October 5, with answers in the November issue.

QUESTION NO. 26: *An engineer employed by a power company, upon examining the plant of a subscriber, becomes aware that the subscriber can save money by making certain changes in certain apparatus in use. Should he inform the subscriber or the power company for which he is working of this fact?*

SOCIETY AFFAIRS

Official and Semi-Official

Salary Study for Milwaukee Area Aided by Society Committee

A RECOMMENDED grading plan with corresponding salary ranges was presented by a special committee of the Society to the Technical Committee, representing the five taxing units, on August 10, 1944. The five taxing units are the City of Milwaukee, the County of Milwaukee, the Sewerage Commission, the School Board, and the Vocational School.

This Society project was initiated by an invitation from the Technical Committee to the Wisconsin Section of the Society under date of July 15, 1944. The Technical Committee expressed its desire to receive whatever significant and pertinent data the Society might care to submit in connection with a detailed survey of 13,500 positions of all types and all grades in the five taxing units. The Wisconsin Section, appreciating the opportunity to be of assistance and desiring to have the benefit of the widest possible sources of information and advice, called upon the Board of Direction of the Society for assistance. The Board, on July 18, authorized President Pirnie to appoint a special committee of the Society and President Pirnie appointed the following members:

Charles S. Whitney, Consulting Engineer, Milwaukee; Chairman
Sidney M. Siesel, President, Siesel Construction Company, Milwaukee
Loran D. Gayton, Assistant City Engineer, Chicago
George M. Shepard, Chief Engineer, Department of Public Works, St. Paul
Allen P. Richmond, Assistant to the Secretary, Headquarters, Am. Soc. C.E., New York

This Committee stated that its sole purpose "is to make an unbiased analysis and report with recommendations as to a sound grading plan for engineering positions and corresponding salary ranges, for the consideration of the Milwaukee Technical Committee and its consultants. To this end it has made use of the best obtainable information from local sources, from nation-wide sources available to this committee, from the experience of many members of the Society who have contributed years of study to similar problems, and from the extensive experience and observations of the members of this committee."

As a further contribution by the Society, Mr. Richmond was instructed to give the matter his personal study. He arrived in Milwaukee July 17 and remained 25 days, making available all desired data from the Society's very extensive files on classifications and salaries and furnishing technical advice. With the Chairman he conferred with the heads of many of the public agencies of the Milwaukee area that employ engineering personnel, studying organization charts, position descriptions and requirements, and discussing the essential elements of the problem.

The Committee held two all-day meetings in Milwaukee outlining the scope of the work, collecting important new data, and furnishing critical review of the recommendations as they were developed. The final recommendations are consistent with the salary report adopted by the Board of Direction on July 18 at its Cleveland meeting, as published in the August 1944 issue of CIVIL ENGINEERING, with appropriate modifications to fit Milwaukee conditions.

The committee's report recommended the establishment of eight professional grades corresponding to the first eight grades in the Society's new grading plan. In addition, the committee recommended four technical (sub-professional) grades starting with the high school graduate without technical training. The technical series overlaps the professional series. The recommended technical grades were strongly influenced by features in the federal sub-professional series for engineering aides and draftsmen.

In addition, the committee recommended salary ranges to correspond to the two series of grades, as follows:

MINIMUM SALARY SCALE

TECHNICAL GRADE	SALARY RANGE
A	$1,740–2,100
B	2,100–2,640
C	2,640–3,240
D	3,240 and up

PROFESSIONAL GRADE	SALARY RANGE
1	$2,100–2,640
2	2,640–3,240
3	3,240–4,080
4	4,080–5,040
5	5,040–6,300
6	6,300–7,800
7	7,800–9,600
8	9,600 and up

The committee stated that "This minimum salary scale is recommended for present-day base pay for new employees assuming no additional cost-of-living bonus. Present employees' salaries should be above the base by an amount representing their past service. This scale may become obsolete because of further increases in labor rates and cost of living, in which case it should be revised upward.

"This committee believes that this scale represents a fair balance between municipal salaries and those in federal service and in private industry when all of the various factors are considered.

"From its intensive study, this committee believes that the recommendations contained in this report represent the minimum standards of qualifications and salaries for engineers which should be adopted at once if the various engineering staffs are to properly serve the public's interests in the management and planning of public works.

"In addition to maintenance of present facilities, much design and construction must be done within the next few years. It is obvious that present engineering staffs are inadequate for the job ahead, and that the present salary schedules are too low to attract men of the qualifications needed to do the work satisfactorily . . . . A salary scale too low to attract high-grade, competent engineers is false economy and not in the best interests of the public."

The complete survey of all positions in public employment in the five Milwaukee taxing units is being made by the Public Administration Service of Chicago, which was engaged by the Technical Committee last fall. Its initial report to the Technical Committee will be made about September 1, for consideration in connection with preparation of the Budget for 1945.

Dues Exempted for Public Health Employees Working with Armed Services

Repeated mention has been made in these pages of action of the Board, whereby members of the Society may apply for exemption from dues, based on military services. Voting (corporate members) and other privileges are retained, but "Civil Engineering" is the only regular publication supplied.

Attention should now be directed to the extension of this plan to similar Society members who are employed by the U.S. Public Health Service, "detailed to duty with the Army, Navy, or Coast Guard." By action of the Board at its July meeting, this enlarged provision is now in effect. As with the previous provision, the new extension can be granted only upon individual application. The necessary blank forms are available on request to Headquarters.

Activities of Committee on Postwar Construction

By G. DONALD KENNEDY, M. AM. SOC. C.E.
CHAIRMAN, COMMITTEE ON POSTWAR CONSTRUCTION

Addressing a recent meeting of the Hampton Roads Engineers Club, G. Donald Kennedy, Chairman of the Society's Committee on Postwar Construction, gave a résumé of the activities of this Committee. Extracts from his address, which set forth clearly the objectives the Committee hopes to attain, are here presented.

POSTWAR PLANNING is a much abused phrase. It can mean almost anything, depending on who is talking about it. It can mean large public works programs, new economic theories, overnight air trips to Moscow, miracle homes, television—well, that is an old story.

The American Society of Civil Engineers, through its Committee on Postwar Construction, is trying to do a very specific job of postwar planning. When postwar planning is here mentioned, it means simply the necessary preliminaries to the actual construction of public and private physical facilities.

FIFTEEN BILLION BASED ON PAST EXPERIENCE

No grandiose ideas about great volumes of public works, or about huge expansion of housing or industrial facilities are held by the Committee. It is not trying to prophesy or to promote those things. What concerns civil engineers is that in the midst of big talk about great postwar plans, this nation is neglecting today to prepare on a bare minimum scale for the construction which the history of the last 20 years shows will be necessary in the first postwar year.

The records of the last 20 years, covering both prosperity and depression, indicate that if our postwar national income is 100 billions a year, total construction and maintenance operations required as a supporting element of that economy will be about 15 billions. The Committee's goal, therefore, is to see 15 billions in public and private construction plans ready for bids by July 1, 1945—one year from now. This is not a big program; it is simply the program that experience dictates will be needed anyhow.

Of this 15 billions, a third is estimated to cover so-called "non-engineered" work such as maintenance, housing built by handcraft, and other light construction. The other 10 billion covers civil engineering construction. The total 15 billion is divided roughly into equal thirds for public works, private housing, and private industrial work.

STATUS OF PLANS

As of June 15, according to national figures prepared by the Committee, "engineered" construction plans under way or completed, totaled 2.6 billion dollars, or hardly more than a quarter of the 10 billion minimum required for the first postwar year. Of this amount, over half was in four states—New York, Ohio, Texas, and New Jersey in that order.

The extent of preparation of highway plans is highly important and gratifying. But highways represent only half of the public works picture in normal times, and only a sixth of total construction averages. So highways cannot be depended on to carry the whole public works load, any more than public works can be depended on to carry more than a third of the total construction program.

As yet there are no reliable estimates on housing and other "non-engineered" construction and maintenance work. Those estimates are being developed now. But with only 2.6 billions in engineered construction plans under way—and much of this still incomplete—it is obvious that postwar planning in America, up to this very moment, is very much empty talking and very little actual preparation.

WARTIME CONSTRUCTION

In certain areas of the United States, a mighty construction and conversion program was carried out to prepare for total war. It was done with all sorts of short-cuts and with cost ruled out as a delaying factor.

Even so, some of that wartime construction is still under way. Before any of it could begin, decisions had to be made first on what facilities to build or convert for war. Financial arrangements had to be made. Land and legal problems had to be overcome. Engineers and architects had to rush through their field inspections, their drawings, their specifications, and construction contracts. Months of such advance work preceded even the "rush" war construction, and that in turn preceded actual production and distribution and use of war material.

The transition from war to peace will require a similar period of preparation for building and converting and modernizing the physical facilities for our peacetime economy. Engineers and architects should be at work all over America today, on private and public assignments, laying the groundwork for resumption of our peacetime economy. Public and private decisions should be made on what construction, conversion, or modernization will be undertaken at the war's end. Finances should be arranged, needed land acquired, and legal problems overcome in advance.

EVILS OF DELAY

All this must leave the talk and dream stage, and get through the action stage, before construction and reconversion can start after the war. Delay in the groundwork will mean delay in the transition to peace—will mean needless unemployment and confusion, and will delay the production and distribution of peacetime goods and services to cope with the pent-up civilian buying power. Delay is an invitation for a serious inflationary period after the war, and for a wasteful make-work employment program to fill the gap while the preliminaries to useful employment are under way.

Until the construction planning work is done, useful employment of workers is held up, both on the site of construction projects and in the industries supplying materials and equipment for the construction program. And in the case of factories, reconversion must be completed before workers can be employed to produce peacetime products.

COMMITTEE PROGRAM—STATEMENT OF POLICY

The policy statement of the Committee on Postwar Construction, which was approved by the Society's Board of Direction in 1943, made specific suggestions on preparations for industrial conversion, private utilities planning, housing, and public works. (See CIVIL ENGINEERING for September 1943, p. 439.)

It laid heavy stress on self-liquidating types of public and private projects, often financed by revenue bonds, which are retired by a charge against the user of the facility. The trend toward this type of project is marked. In the public works field at least, its advantage is that it requires no increase in public bonded debt or general taxes.

In the field of public roads and streets, which historically makes up half of all public works, this self-liquidating feature has been in force for many years. Highway users pay special gasoline and license taxes and other fees to finance road improvements made for their benefit. How well this has worked is shown by the studies of the Federal Coordinator of Transportation, which show that highway users pay their full share of costs for all road and street improvements in the nation, and that such improvements do not cost the general public one penny.

FIVE MAJOR ACTIVITIES

To implement its policy statement, the Society's Committee on Postwar Construction has established a Research and Development Division with headquarters in New York City, and with five major activities under way.

1. *Local Sections Get Postwar Committees.* First and foremost each Local Section of the Society is encouraged to establish a local committee on postwar construction and to carry out a number of local activities. From its contact and counsel with these Local Sections, the Committee is able to make suggestions based on successful local operations throughout the nation. Federal developments are watched through the District of Columbia Local Section, and information is thus provided to all Sections on national developments.

2. *C.E.D. Pilot Studies.* The second major activity is a pilot study looking toward integration of the Society's local planning

program with the community organization setup of the Committee for Economic Development. Local Sections in Cleveland, Ohio; Allentown, Pa.; and Fredericksburg, Va., were selected for initial testing of this plan of participation with the Committee for Economic Development. If the program proves effective in these three cities, ranging in population from 10,000 to one million, it will be followed by similar action on a national basis.

3. *National Organizations.* The third activity is one of seeking close relationship with other national organizations, and carrying this relationship into state and local activities of all these organizations. For example, the Committee is working in cooperation with the American Society of Planning Officials and the American Municipal Association in fostering Planning Institutes for the benefit of local communities in various regions of the nation.

4. *Reporting Service.* The fourth phase of our program involves a special and unique arrangement made by the Society with the McGraw-Hill Publishing Company for the use of the national construction reporting service of *Engineering News-Record* which enables the Research and Development Division to prepare monthly inventories of postwar construction projects. These statistics are available to all trade and technical journals in America, and to any other interested person or agency. Special breakdowns of these construction inventories are being developed and will soon be available for every state and all but the smallest cities, on a total and per capita basis, and with distinctions between work being planned and work actually ready for construction bids. Up to now, the planning under way in each state is simply listed and divided into various types of public and private projects, with totals for each type.

5. *Public Information Service.* The fifth and final activity is a public information service, which includes a monthly news release on construction statistics, available to all interested agencies and publications. Daily and weekly newspapers will be given news releases of general interest as soon as sufficient localized data are available. Special local press campaigns are being worked out for certain areas of particular interest.

Depends on Local Engineers

Success of this construction planning program depends on local engineers, who know the problems of their own areas and can help their local and state, public and civic, and business leaders come to sound and early decisions on work that should be prepared for in advance of the war's end. Their suggestions, and energetic work in their own areas, alone can make the program effective.

Federal Planning Loans Through Federal Works Agency

On the Congressional front, the Society's Committee has supported proposed legislation under which a federal revolving fund would be established, administered by the Federal Works Agency, to make loans to state and local public agencies for postwar public construction planning. These loans, which would cover only the cost of engineering and architectural preparations for construction, would involve no federal obligation to participate in the cost of actual construction, and the loans would be repayable as soon as state or local construction funds were authorized for the projects.

This legislation seeks to recognize the fact that a majority of state and local governmental units are marking time in making actual preparations on definite projects in order to see what federal public works aid, if any, will be available after the war.

The fact is, of course, that such federal aid will depend on postwar conditions, which are hard to anticipate. But meanwhile, a basic need for final plans and specifications on necessary state and local public works is not being met in a majority of states. Whether or not federal aid is forthcoming, the war-deferred backlog of public improvements exists, and engineering plans should be completed for the work. If the final preparations are made, the risk of a make-work employment program will be avoided. Such make-work projects are the penalty we pay for not having sound plans ready.

Postwar Highway Planning

Only in one field—that of highways—is advance engineering planning being done on a substantial scale nationally. In part, this is due to the fact that highway engineers are used to a regular continuing construction and maintenance program, and traditionally prepare in advance for future work. Much of the credit also is due to 1941 and 1943 Congressional action, which made a total of 60 millions available to the state highway departments, subject to 50–50 matching, for advance engineering plans and acquisition of right of way.

Pending now before Congress, after unanimous approval by the House Roads Committee, is a postwar highway bill which, in the words of the U.S. Commissioner of Public Roads, Thomas H. MacDonald, Hon. M. Am. Soc. C.E., "will set the course of highway development in America for the next quarter-century." This bill, H.R. 4915, authorizes $1^1/_2$ billions in federal highway funds for the first three postwar years, subject to 40% state and local matching in the first postwar year and 50–50 matching thereafter.

The funds are to be distributed by formula to the state highway departments. For the first time, a specific sum is earmarked for city highway improvements—30% of the total. Of the federal funds, 45% go to main federal-aid highways, both in and out of cities, and the remaining 25% to farm-to-market roads. The states are to decide the projects to be eligible for this federal aid by consultation with city and county highway agencies, and supervision of the program on a national basis remains as always with the Public Roads Administration.

The need for these modern highways, which drastically reduce accidents and virtually eliminate congestion through engineering design, will be very apparent within a few years after the war. The auto industry plans to produce at least six million vehicles a year for a number of years after the war, which is nearly double the normal past average. Traffic is going to increase far above prewar peaks—and that means a proportionately greater increase on main roads and streets, which already were saturated with traffic and riddled with accident hazards before the war.

Postwar highway planning is moving fast from a state level, but it is slow in getting started from the urban level. In the highway field, and in the general public and private construction planning field, there is urgent need for local community leadership today by civil engineers, who know the general engineering solutions that must be applied locally and who know the advance steps that must be taken if postwar planning is to mean action at the war's end.

Committee Welcomes Suggestions

The American Society of Civil Engineers' Committee on Postwar Construction is anxious to help in every possible way, and welcomes suggestions and local requests for assistance. The war is not over by a long sight, and nothing must interfere with support to our fighting men. But unless this nation has 15 billions in construction plans ready for bids by next July 1, the grave risk must be run of delaying postwar reconversion, and of bringing our fighting men home to face unemployment and make-work jobs. At best, waste and confusion are invited in the transition back to the peace that our armed forces are winning now.

WPB Structural Design Specifications Considered by Section Committee

In connection with the work of the Committee on Postwar Planning of the District of Columbia Section of the Society, C. A. Willson, M. Am. Soc. C.E., made the following report. This report deals with the postwar use of the three structural design specifications issued by the War Production Board known as:

- National Emergency Specifications for the Design, Fabrication and Erection of Structural Steel for Buildings (See Civil Engineering for January 1943, p. 63)
- National Emergency Specifications for the Design of Reinforced Concrete Buildings (See Civil Engineering for January 1943, p. 64)
- National Emergency Specifications for the Design, Fabrication and Erection of Stress Grade Lumber and Its Fastenings for Buildings (See Civil Engineering for September 1943, p. 452)

These specifications were issued as war emergency measures, and the power of the War Production Board ceases as soon as the emergency is ended. During the past several months, the question of postwar use has arisen many times and has been discussed freely. As a consequence, expressions of opinion have been received by the WPB from a great many engineers who are representatives of the government, technical societies, trade associations, and industries themselves. In each case, it is believed that key

men in each of the three particular fields have been consulted, but in no case has it been felt necessary to contact a large number of engineers in any one of the three fields.

In the first place, it should be recognized that engineers generally dislike federal dictation in regard to design procedures or working stresses. Similarly, building code officials, both local and state, resented the fact that their ordinances were arbitrarily brushed aside and superseded by these three emergency specifications. However, in the great majority of instances, the WPB has received excellent cooperation.

Over half of the engineers who were contacted preferred to see a return to the prewar design specifications with an immediate re-study and review of the experience gained during the war period. It is to be assumed that such a re-study might result in the adoption of certain features of the emergency specifications. A somewhat smaller number favored the continuation of the provisions of the emergency specifications, without change after the war. They believe that improvements in design, fabrication, and construction methods warrant the increased working stresses which were put into effect as emergency measures.

The comments that have been received may be classified in another manner. In general, those interested in structural steel and new billet reinforcing steel, and most of the governmental representatives, favored a return to the prewar basis with an accompanying review and re-study. Those interested in cement, rail-steel reinforcing bars, structural lumber, and a few governmental representatives, favored the continuance of the provisions of the emergency specifications after the war.

Reprints Available—Salary Classification and Compensation Plan

Professional civil engineering positions were classified and a compensation plan established by action of the Board of Direction at its meeting in Cleveland on July 18, 1944. In presenting this plan to the Board, the Committee on Salaries recommended its publication with provision for reprints. It was published in the August number of "Civil Engineering" pp. 364–366, and has now been reprinted. Reprints are 15 cents each, and may be obtained on request from the American Society of Civil Engineers, 33 West 39th Street, New York 18, N.Y.

To Validate Society Ballots

ONE SPECIAL feature of the ballots for official Society nominees, canvassed August 1 and reported in this issue, is the number that could not be accepted. Almost 100 were included in this class for one reason or another. In most cases, the loss of the ballot was for causes within the control of the member himself.

The largest group of ballots that could not be counted included those sent by members who were in arrears of their dues. The answer to this difficulty is a personal problem in each case; some were doubtless in arrears because of avoidable delay or procrastination in sending in dues. Such loss of vote is regrettable.

Another large group wasted their ballots by voting for ineligible candidates—that is, for present officers. According to the Constitution, Article V, an officer cannot succeed himself until one term has elapsed. Thus these voters in effect threw away their ballots.

A third group was disfranchised for a minor failure to meet the rules—they did not supply a legible signature. The regulation states that the member's signature must appear on the back of the outside envelope, in the space conveniently provided for it. This signature serves a twofold purpose at Headquarters: (1) It is verified with the specimen on file before the ballot can be certified to the Tellers as originating from a Corporate Member in good standing (Juniors, Affiliates, and Fellows are not permitted to vote); and (2) an individual check is made of each returned ballot to ascertain the current dues status of the member.

Throughout the years certain of the staff at Headquarters have become very proficient in reading signatures. Therefore, to be disqualified on this count, a voter must have been very careless indeed in the matter of his signature. To save countless hours wasted in deciphering signatures on returned ballots, hereafter the member will be requested to print his name under the written signature.

These rules will apply in the case of all future ballots—that is, a member must be current with his dues, he must vote for an eligible candiate, and his signature must be written legibly. It might happen that the member was very anxious that his vote be counted, in which case these regulations would be especially important. But even where no great urgency is felt, members should take sufficient pride in their Society to record their vote—and effectively.

President Pirnie Presents Society's Postwar Policy to House Committee

THE POSTWAR PROGRAM proposed by the Board of Direction of the Society was outlined at a meeting of the Public Works Subcommittee of the House Special Committee on Postwar Economic Policy and Planning. The speaker for the Society at this session, held July 27, in New York, N.Y., was President Malcolm Pirnie. He appeared at the invitation of Representative Walter A. Lynch of New York, chairman of the subcommittee.

Urgency of plan preparation was stressed by President Pirnie as he added an account of recent developments to the program proposed by the Board of Direction over a year ago. (See CIVIL ENGINEERING, September 1943, p. 439.) Among recent activities reported was the establishment of the Research and Development Division of the Society's Committee on Postwar Construction which, through the cooperation of the McGraw-Hill Publishing Company, prepares a monthly report of postwar plans under way.

The program had previously been recorded in hearings before the Committee on Public Buildings and Grounds, House of Representatives, Seventy-Eighth Congress. (See CIVIL ENGINEERING for March 1944, p. 127.) Some 25,000 copies of this record were sent to governors, mayors, agencies, and organizations throughout the United States.

In his statement, President Pirnie said:

"The Congress can recreate faith in the future needed by free enterprise to convert its ideas into action. This will involve concise legislation to implement the intent and purpose of the Baruch-Hancock Report on reconversion of war productions to peacetime activities. It will involve attention to agencies of Congress to restrict their activities within their authorizations and submit their rulings to legal review that will insure adherence to the law established by the Constitution. It will involve radical revision of the wartime income tax law to effect a peacetime law directed entirely to equitable production of the necessary revenue and devoid of punitive intent against the successful and lawfully conducted activities of free enterprise. It will also involve care to avoid government competition with established privately financed and operated businesses and services, particularly where new services are to be provided at public expense, in which cases commensurate reductions in taxes upon established competing services should be authorized to establish equality of incentive for each needed type of service to improve and perfect the operations for which it is best suited."

Colorado Section to Entertain October Board Meeting

SIMPLICITY and absence of technical sessions will mark the joint activities of the Board of Direction and the Colorado Section, at the time of the Board's regular fall meeting in October. The dates are Sunday, October 8, to Tuesday, October 10, and the place, the Brown Palace Hotel in Denver.

In accordance with regular procedure, committees of the Board will meet on Sunday, while the usual sessions of the Board itself will occupy all of Monday and probably most, if not all, of Tuesday. On Tuesday, also, an all-day Local Sections Conference is scheduled. This will draw attendance from representatives of the various Sections covering the Pacific Coast, the Mountain states, and as far east as Texas. With the Sections unusually active in problems incident to war work and professional matters, this Conference should be stimulating.

Besides participating in the Conference, members of the Local Section are planning to entertain the Board members and other Society visitors. This program includes a dinner on Monday evening and a luncheon on Tuesday.

Tellers Report on First Ballot for Official Nominees

To the Secretary *August 1, 1944*
American Society of Civil Engineers

The tellers appointed to canvass the First Ballot for Official Nominees report as follows:

For Vice-President, Zone II

A. C. Polk	434
Scattering	136
Void	1
Blank	7
Total	578

For Vice-President, Zone III

Ernest E. Howard	443
H. S. Morse	330
Joseph E. Root	115
Scattering	49
Void	0
Blank	1
Total	938

For Director, District 1
(Two to be elected)

Thorndike Saville	173
Charles W. Bryan, Jr.	166
Leon G. Cutler	12
Scattering	107
Ineligible candidates	83
Void	2
Blank	8
Total	551
(One-half of above figure)	276

For Director, District 4

Howard T. Critchlow	45
Scattering	8
Ineligible candidates	9
Void	0
Blank	1
Total	63

For Director, District 11

John H. Gardiner	192
Ineligible candidates	34
Scattering	12
Void	0
Blank	0
Total	238

For Director, District 14

H. F. Thomson	140
Edward R. Stapley	42
Scattering	6
Ineligible candidates	0
Void	0
Blank	1
Total	189

For Director, District 15

Oscar H. Koch	202
Scattering	16
Ineligible candidates	29
Void	0
Blank	0
Total	247

Ballots canvassed		2,529
Ballots withheld from canvass:		
From members in arrears of dues	71	
Without signature	18	
Illegible signature	3	92
Total number of ballots received		2,621

Respectfully submitted,

FRANK L. GREENFIELD, *Chairman*
DAVID G. BAILLIE, JR., *Vice-Chairman*

Joseph Farhi	William L. Hanavan	Constantin P. Melioransky
John J. Kelly	Bertalan Schoen	Jacob Mechanic
Harry Newman	George L. Freeman	Henry A. Foster
George C. Maguire	Alfred M. Wyman	George G. Dixon
Ernest H. Harder	Louis Goodman	
James M. Webster	Emanuel L. Pavlo	*Tellers*

1944 Transactions May Be Delayed

ONE of the important summer assignments at Headquarters is the preparation of the yearly volume of TRANSACTIONS, issued in the fall. In spite of all precautions that could be taken, it now appears that the normal date of issue, in October, may not be maintained this year.

Only one cause is responsible for this condition—the shortage of paper supply. Although ordered in 1943, the delivery of the Bible paper for TRANSACTIONS has been unduly delayed. The editors are ready and the printers are ready. The paper manufacturer is also ready—if only he can obtain the stock with which to work. There seems to be no recourse but to be patient.

Part of the large volume of TRANSACTIONS has already been printed and the remainder will go forward as soon as paper stock is available. It appears at present that the volume cannot be issued as Part 2 of the October PROCEEDINGS, its normal status. Every effort will be made to put it in the mails as early as possible. Members who are anxious to obtain their TRANSACTIONS can take some comfort in the fact that their own inconvenience is directly attributable to the promotion of the national war effort.

Booklet on Postwar Traffic Safety Available

ACTION now in preparing to handle postwar traffic is essential. A program sponsored by the American Society of Civil Engineers and other interested organizations has been prepared by the Committee on Postwar Traffic Safety Planning of the National Safety Council. The plan calls for immediate action in every community and state to prepare in advance for meeting the complex problems that will arise when the restrictions on travel are lifted, and pledges "full cooperation to federal, state and local officials who must do the job."

The program is set forth in a booklet entitled "Danger—Traffic Jam Ahead." Pointing to the 39,969 traffic deaths in the last prewar year of 1941, the Committee states, "Socially we cannot countenance the unnecessary carnage—economically we cannot afford the attendant financial loss. We must, then, prepare now to meet the traffic problems which will surely arise."

In appraising the postwar traffic outlook, the Committee has foreseen numerous problems, the solution of which will require "an informed public opinion and a broader degree of cooperation and coordination among all of the agencies involved, government or otherwise."

The old age and inadequate maintenance of motor vehicles are listed among these factors. Delayed construction and maintenance of streets and highways will leave these inadequate and in poor condition. Restricted driving has lowered the experience and skill of many drivers. Accident prevention programs of government departments and of civic organizations have depreciated for lack of personnel.

Pedestrian safety measures have been neglected in many places during the period of reduced traffic activities. The general pattern of traffic may change further in many communities, owing to different business and residential distributions. Delayed installation and improvement of street and highway lighting, and depreciation of vehicle headlights will increase night hazards.

The program recognizes that there is no easy panacea for these and other postwar traffic problems, and that measures must be fitted to local conditions as problems develop. For complimentary copies of the 20-page pamphlet entitled, "Danger—Traffic Jam Ahead," address the National Safety Council, 20 North Wacker Drive, Chicago 6, Ill.

Prompt Resumption of Civilian Construction Urged at Meeting with Donald M. Nelson

A COMMITTEE of representatives of the construction industry, at a meeting on August 3 with Donald M. Nelson, Chairman of the War Production Board, emphasized the need for prompt resumption of civilian construction as labor and materials become available. The American Society of Civil Engineers is represented on the Committee, brought together by the Chamber of Commerce of the United States, by Allen J. Saville, M. Am. Soc. C.E. Mr. Saville is Chairman of the Committee. Mr. Chandler, the Society's Washington Representative, also attended the meeting.

The committee recognized the responsibility of the construction industry as one of the first industries that must get started immediately after war work ceases if employment is to be supplied. Several months could be saved in the resumption of all types of construction work if assurance could be given that necessary materials and equipment could be produced and made available for civilian construction as rapidly as war needs permit. Since the supply of construction materials and equipment is nearly exhausted, it will be essential, the committee declared, to start replenishing the supply at the earliest practicable time.

When the transition period arrives, positive stimulation will be needed to get reemployment in process, the group told Mr. Nelson. It stressed its conviction that industry and constructors should be relied upon to decide which work should go forward first. Where projects are ready to start and where men and materials become available, priorities assistance and other necessary encouragement should be given to enable the work to get under way promptly. Such a procedure would require a minimum of regulation or direction from Washington. If supplemented with provision for the manufacture of needed equipment, this program would insure an increase in civilian jobs during the critical transition period.

The committee, after its meeting with Mr. Nelson, expressed confidence that the War Production Board would take steps to insure a speedy resumption of construction activity. Mr. Nelson told the committee that its suggestions were helpful in projecting plans for reemployment.

Members of the Construction Industry Committee which met with Mr. Nelson, in addition to Mr. Saville and Mr. Chandler are:

Raymond J. Aston, President, American Institute of Architects
Wilson Compton, Secretary-Manager, National Lumber Manufacturers Association
Robert P. Gerholz, President, National Association of Home Builders
Norman P. Mason, Regional Vice-President, National Retail Lumber Dealers Association
William Muirhead, President, Associated General Contractors of America.
E. P. Palmer, Chairman, Construction and Civic Development Department, U.S. Chamber of Commerce
Douglas Whitlock, President, The Producers' Council

F. Stuart Fitspatrick, Manager of the Construction and Civic Development Department of the U.S. Chamber of Commerce, is Secretary of the Committee, which was selected from the Chamber's larger Construction Industry Advisory Group.

News of Local Sections

Scheduled Meetings

DAYTON SECTION—Luncheon meeting on September 18, at 12:15 p.m.

DISTRICT OF COLUMBIA SECTION—Meeting at the Cosmos Club on September 21.

LOS ANGELES SECTION—Dinner meeting at the University Club on September 13, at 6:30 p.m.

NEBRASKA SECTION—Dinner meeting at the Paxton Hotel, Omaha, on September 12, at 6:30 p.m.

NEW MEXICO SECTION—Talk on airlines operation by Freeman Fish, N.Mex. Dist. Mgr., Continental Air Lines, at the University of New Mexico on September 14, at 7:30 p.m.

SACRAMENTO SECTION—Regular luncheon meetings at the Elks Club every Tuesday at 12:15 p.m.

SAN FRANCISCO SECTION—Dinner meeting of the Junior Forum at the Engineers Club on September 28, at 5:45 p.m.

ST. LOUIS SECTION—Luncheon meeting at the York Hotel on September 25, at 12:15 p.m.

TENNESSEE VALLEY SECTION—Regular meeting of the Chattanooga Sub-Section on September 11, at 6 p.m.; dinner meeting of the Knoxville Sub-Section at the S & W Cafeteria on September 13, at 7 p.m.

Recent Activities

PUERTO RICO SECTION

On May 23 the Puerto Rico Section gave a dinner at San Juan in honor of Malcolm Pirnie, President of the Society. Ernesto A. Soler-Lopez, president of the Section, introduced Mr. Pirnie to the gathering, and appointed Etienne Totti toastmaster for the occasion. The latter called upon Francisco Pons, representative of the Sociedad de Ingenieros de Puerto Rico, to say a few words, and Mr. Pons responded with a brief description of the purposes and objectives of his organization, and expressed his views on pan-Americanism as applied to Puerto Rico. Following his talk, Mr. Pirnie answered questions on the subject of pan-Americanism and collective bargaining as interpreted by the Society. One of the pleasant surprises of the evening was the introduction of Miss Pirnie, who had accompanied her father and who, when called upon to speak, did so in clear and fluent Spanish.

SACRAMENTO SECTION

At an evening meeting held on July 11, Harry N. Jenks, member of the San Francisco Section and consulting sanitary engineer of Palo Alto, discussed Sacramento's sewage problem—a postwar project that has aroused much civic interest and controversy because of the recent regulation of the Sacramento River by Shasta Lake. Mr. Jenks illustrated his address with slides of recent installations by other cities and by the U.S. Corps of Engineers. Interesting speakers on non-technical subjects were heard at luncheon meetings, held on July 18 and 25.

SEATTLE SECTION

The May meeting of the Section took place in the hydraulics building of the University of Washington on the 29th. A. L. Miller, chairman of the meeting, discussed the complexities of international relations in the political and economic sphere, as contrasted with the ease with which engineers collaborate on an international basis, and introduced the members of the engineering staff of the International Pacific Salmon Fisheries Commission. Other speakers were Milo Bell, engineer for the Commission, who discussed the circumstances leading to the construction of the Fraser River project; and C. W. Harris, civil and hydraulic consultant for the Commission, who explained the design of the Hell's Gate Fishways, the present focal point of the project. The meeting was then adjourned to permit the members to inspect the hydraulic model of Hell's Gate, and various models of the fishways in operation.

ITEMS OF INTEREST

About Engineers and Engineering

On Land Titles

THE FOLLOWING story, sent in by Thomas A. Cullum, Jr., Jun. Am. Soc. C.E., illustrates the care used by the Defense Plant Corporation in investigating land titles to proposed plant sites.

The Defense Plant Corporation, making a routine investigation of the titles to a proposed plant site in Louisiana, received title proof as far back as 1803. A legal adviser was not satisfied with this and wrote for evidence as to prior titles. He received the following reply from a Louisiana attorney:

"Gentlemen:

"I note your comment upon the fact that the record of title sent you as applying to the lands under consideration dates only from the year 1803, and your request for an extension of the records prior to that date.

"Please be advised that the government of the United States acquired the territory, including the tract to which your inquiry applies, by purchase from the government of France in the year 1803. The government of France acquired title by conquest from the government of Spain; the government of Spain acquired title by discovery by one, Christopher Columbus, a resident of Genoa, Italy, traveler and explorer, who by agreement concerning the acquisition of title to any lands discovered, travelled and explored under the sponsorship and patronage of her Majesty the Queen of Spain. And the Queen of Spain had verified her arrangement and received sanction of her title by the consent of the Pope, a resident of Rome, Italy, and ex-officio representative and vice-regent of Jesus Christ. Jesus Christ was the son and heir apparent of the Almighty God from whom He received His authority and the Almighty God made Louisiana.

"I trust this complies with your request."

Sanitary Corps Seeks Engineers for Commissions

THE War Department has granted the Sanitary Corps authority to commission an additional 211 sanitary engineers in the grades of Second Lieutenant, First Lieutenant, and Captain. Qualifications are a degree from a recognized college or university in civil, sanitary, or chemical engineering, and: 2 years of experience in sanitary engineering for Second Lieutenant; 4 years for First Lieutenant; and 8 years for Captain (for applicants between 38 and 42 years of age).

Further information can be obtained from the Officer Procurement Service Office, in each Service Command Headquarters, or from the Officer Procurement Service, War Department, Munitions Building, Washington 25, D.C.

N. G. Neare's Column

Conducted by

R. ROBINSON ROWE, M. AM. SOC. C.E.

"DURING DINNER," said Professor Neare, "someone asked me who Rollo was, so I'll tell you the legend that Ned and Dick heard in Normandy to explain his mirrored boudoir. The viking, Hrolf, having overrun that part of his kingdom, Charles le Simple tried to trick him out of his conquest. In a four-point treaty, he made the Norman chieftain a Duke, a son-in-law, a Christian, and a 'Frenchman' named Raoul. Norman tongues made that name 'Rou' (whence Rouen, his capital), but history compromised on 'Rollo.'

"Charlie's simple idea was that the Duchess would be the boss, but Rollo had ideas too. One was the boudoir so mirrored that the Duke from his chair could watch his Duchess on her chaise longue, directly and from four angles. The reflections being half-size from mid-points of equal walls, how large was the boudoir?"

"I have a compact solution," ventured Joe Kerr. "While the wife entertained her sewing circle, I borrowed mirrors and lipstick from compacts and set up a model boudoir. The thrones being 10 ft apart directly and 20 ft via each mirror, the mirrors were on an ellipse with semi-axes $a = 10$ and $b = 5\sqrt{3}$. Since focal radii make equal angles with the normal, the mirrors were tangent to the ellipse, forming a square with an area of 350 sq ft. The ellipse won't be tangent to mid-points of square, but Rollo could have seen his Duchess near the edge of a 3-ft mirror."

"Who said the room was square?" asked Cal Klater. "Stein-like, a *room* is a *rhom* is a *roomb*. In Fig. 1, if M_1M_2 and

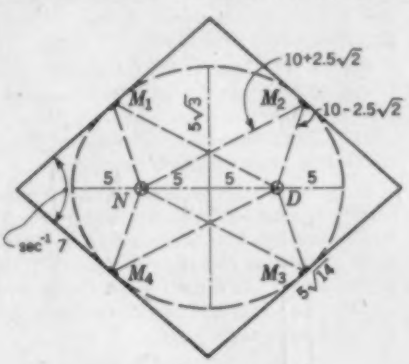


FIG. 1

M_3M_4 are the equal conjugate diameters, then tangents at the M's will form the required rhombus for Rollo's rumpus room. The dimensions are: side, $\sqrt{2a^2 + 2b^2} = \sqrt{350}$; diagonals, $a\sqrt{8} = \sqrt{800}$ and $b\sqrt{8} = \sqrt{600}$; area, $4ab = 200\sqrt{3}$. May I add that this cynic doubts that Rollo did much rollicking if he kept his wife constantly 10 ft away!"

"Who are we to worry," answered the Professor, "if he kept her constantly, period. The rhomb and your dimensions check the measurements of Ned and Dick. All I can add is that secants of angles of the rhomb are $\pm\dfrac{a^2 + b^2}{a^2 - b^2} = \pm 7$.

"I have invited Isidore Knobbe to be Guest Professor and pose you a poser for next time. I warn you, he has a flare for topology, so watch your transformations."

"I resent that warning, Noah, because mine is a square-shooting problem—no tricks like dressing rhombs up to look like squares. I'm going to start with squares and call them squares.

"A friend of mine, Jerry D. Taynor, just laid out a prison farm on Duster Flat in Oklahoma, fencing off three separate square areas for (1) German prisoners, (2) Jap prisoners, and (3) a hospital compound. The corrals were so located that each fence could be enfiladed from some one of four guard towers built in abandoned oil derricks. Three of these derricks were, respectively, 600 ft N60°E, 2,100 ft East, and 1,700 ft S60°E from the fourth. How large were the corrals?"

"Thanks, Isidore. I'll try it myself."

[*Cal Klaters were Isidore Knobbe (the Guest Professor, sometimes called Joseph S. Lambie), Anne Othernut (J. Charles Rathbun), Richard Jenney, and O'Kay (Otto Koch).*]

Research Positions Open

NEVER before has the supply of able scientists seemed so small in relation to the demand. The Office of Scientific Personnel of the National Research Council has been receiving a large number of requests for this type of personnel. These requests are from industrial and governmental laboratories interested in research personnel as well as from colleges desiring teachers and from industrial establishments seeking a wide variety of scientifically trained persons.

The Office of Scientific Personnel has been set up in the National Research Council to serve in the war emergency. One of its functions is to assist in the recruitment of scientists for positions in war-supporting activities. It is in touch with demands from all types of activities and is in a position to refer an able scientist to employers engaged in urgent work.

It is therefore suggested that any persons who are or may be available for employment, who are experienced in research or applied science, or who have substantial training in this field, write at once to:

Dr. M. H. Trytten, Director
Office of Scientific Personnel
National Research Council
2101 Constitution Avenue
Washington 25, D.C.

NEWS OF ENGINEERS

Personal Items About Society Members

ALLSTON DANA has accepted the position of bridge designer with the engineering firm of Gannett Fleming Corddry and Carpenter, Inc., of Harrisburg, Pa. At one time chief designing engineer for the Port of New York Authority, Mr. Dana recently returned from a year's stay in North Africa where he was in charge of the construction of equipment repair shops for the British Government. JOHN R. DIETZ, until lately engaged on war construction for the U.S. Engineer Department, will be in charge of highway design for Gannett Fleming Corddry and Carpenter, Inc.

W. C. MULDROW, who was with the Corps of Engineers, U.S. Army, in 1941 and 1942 on Alaskan and Aleutian defense projects, is now in the Economics Section of the Portland (Ore.) District office of the Corps.

WILLIAM G. HOYT, principal hydraulic engineer for the Water Resources Branch of the U.S. Geological Survey, has been appointed vice-chairman and executive officer of the Department of Water Resources Committee of the U.S. Department of the Interior. Also appointed to the committee was GLENN L. PARKER, chief hydraulic engineer for the Geological Survey.

DANIEL C. FROST, formerly assistant professor of civil engineering at Newark College of Engineering, is now staff industrial engineer with the Armstrong Cork Company, of Lancaster, Pa. While Mr. Frost was on the faculty of the Newark College of Engineering, he received two citations for his work as Faculty Adviser for the Student Chapter.

LYNN W. PINE, lieutenant colonel, Corps of Engineers, U.S. Army, was recently made commanding officer of the First Airborne Engineer Aviation Unit Training Center, for which he was formerly executive officer.

HENRY L. BOWLBY is now an associate in the newly established firm of Crowley, Stapleton and Associates, Inc., consultants in management, production, research, and engineering development, with headquarters at 407 South Dearborn Street, Chicago, Ill.

HAROLD A. KEMP has resigned as head engineer in the Office of the Chief of Engineers, U.S. Army, in order to become director of sanitary engineering for the District of Columbia. In this capacity he will have charge of all water, sewerage, and refuse work, succeeding the late JOHN BLAKE GORDON.

JOHN C. HOYT retired at the end of June as consulting engineer to the Water Resources Branch of the U.S. Geological Survey. Mr. Hoyt, who is an authority on water-supply and stream-gaging problems, had been in the Water Resources Branch of the Survey since 1902.

HARDY CROSS, professor of civil engineering and chairman of the department of civil engineering at Yale University, is this year's recipient of the Lamme Medal ". . . for his development of revolutionary methods of analysis in structural engineering; for his application of these methods to the rigorous training of civil engineers; for his insistence on the great responsibilities of the individual teacher and his scorn of the superficial in education, ..." The medal was presented to Professor Cross at the June 22–25 meeting of the Society for the Promotion of Engineering Education, which was held in Cincinnati.

LACEY V. MURROW, colonel, Corps of Engineers, U.S. Army, has been awarded the Legion of Merit for inventing a device that is reported to have saved the lives of many bulldozer operators. Colonel Murrow has been on duty in the South Pacific area.

FRANK F. BELL has been promoted from the rank of lieutenant colonel in the Corps of Engineers, U.S. Army, to that of colonel. Prior to being called to active duty, Colonel Bell was vice-president of the Uvalde Construction Company, of Dallas, Tex.

GORDON R. YOUNG, brigadier general, Army of the United States, was recently appointed Commanding General of the Post of Fort Belvoir, Va., the location of the Army Engineer School, Engineer Board, and ASF Training Center. Previous to this assignment, General Young had served for several years in Panama as chief engineer of the Caribbean Defense Command.

HENRY L. DOTEN, who is on military leave from the University of Maine, where he formerly served as business manager, is a major in the Corps of Engineers, U.S. Army. Major Doten is chief of the Training Contracts Branch, Purchases Division, Army Service Forces.

JOHN S. BARLOW, consulting engineer of Dallas, Tex., is the recipient of the Meritorious Civilian Service Award of the Bureau of Yards and Docks for his work on the construction of the Naval Air Station at Corpus Christi, Tex. He was principal engineer for Brown-Bellows-Columbia, contractors on the project, and not officer-in-charge of construction, as stated in the June issue.

EDWIN H. MARKS, brigadier general, Corps of Engineers, U.S. Army, has been transferred from Fort Belvoir, Va., to Dallas, Tex., where he will assume duties as Southwestern Division Engineer.

E. L. FILBY has returned to his regular work as principal assistant engineer with Black and Veatch, of Kansas City, Mo., after a leave of absence, during which he served as field director for the Committee on Water and Sewage Works Development in its postwar campaign.

O. W. CROWLEY has accepted reemployment as executive secretary of the Central Branch of the Associated General Contractors of America at Des Moines, Iowa—a position he had held for twenty years before going to Alaska in 1942 to work on the Alaska Highway.

JAMES H. STRATTON, brigadier general, Corps of Engineers, U.S. Army, is one of four Army Engineer officers recently awarded Legion of Merit medals. This honor is given for his services from [illegible] cember 1941 to November 26, 194[illegible] chief of the engineering division, Offi[illegible] the Chief of Engineers, Washington, w[illegible] "he displayed unusual foresight in [illegible] adaptation of the design of military [illegible] struction in the United States to the [illegible] ditions imposed by reduced availability [illegible] material, labor, and construction equ[illegible] ment." At present General Stratton [illegible] assistant chief of supply, Headquart[illegible] Staff, European Theater of Operations.

JOHN F. JOHANNSEN, until lately in [illegible] International Branch Office of the Ch[illegible] of Engineers, U.S. Army, with he[illegible] quarters in Washington, D.C., has be[illegible] appointed export manager for the Hy[illegible] Company, of Portland, Ore., and Pe[illegible] Ill.

EARNEST BOYCE has accepted appoi[illegible] ment at the University of Michigan [illegible] professor of municipal and sanitary en[illegible] neering in the College of Engineering a[illegible] professor of public health in the Sch[illegible] of Public Health. Since 1941 Profes[illegible] Boyce has been on leave of absence fr[illegible] the University of Kansas as water supp[illegible] consultant to the Quartermaster Gene[illegible] and, later, as senior sanitary engineer f[illegible] the U.S. Public Health Service, with hea[illegible] quarters in Washington, D.C.

DECEASED

WILLIAM PEARSON ADAMS (Jun. '[illegible] Ensign, U.S. Naval Reserve, died in [illegible] line of duty at Magazine, Ala., on July 1[illegible] 1943. He was 25. At the time of h[illegible] graduation from the University of Ar[illegible] zona in 1943, Mr. Adams received th[illegible] Arizona Section's prize of Junior mem[illegible] bership in the Society.

HENRY EXALL ELROD (M. '15) consul[illegible] ing engineer for the rubber department [illegible] the Defense Plant Corporation at Hou[illegible] ton, Tex., died on July 18, 1944. Mr. E[illegible] rod, who was 65, was in private practice [illegible] a consulting municipal engineer from 19[illegible] on—with offices, successively, in Dall[illegible] Tex., Santa Monica, Calif., and Houst[illegible] Earlier in his career (1903 to 1906) he w[illegible] general manager of the Bartlett Steel Co[illegible] pany (later the Southwestern Bridge Co[illegible] pany) at Joplin, Mo., and from 1907 [illegible] 1910 general manager of the Houst[illegible] (Tex.) Structural Steel Company.

CHARLES DORMAN EVANS (Assoc. M[illegible] '21) senior construction engineer for th[illegible] Federal Works Agency at Fort Wort[illegible] Tex., was fatally stricken in his office the[illegible] on June 30, 1944. He was 65. Except fo[illegible] a brief period in 1940 and 1941, Mr. Eva[illegible] had been with the FWA and the PW[illegible] since 1935. Earlier he was engaged [illegible] railroad engineering, and he had mai[illegible] tained a private practice, specializing [illegible] municipal projects. He had been chief e[illegible] gineer for the Louisiana State Conserv[illegible] tion Department, and from 1930 to 193[illegible] was city commissioner of streets and par[illegible] for Shreveport, La.

SAMUEL HAMILTON HEDGES (M. '0[illegible] retired civil engineer of Seattle, Was[illegible] died in that city on June 28, 1944. Pro[illegible]